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THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, TRINIDAD, B.W.I.

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THE NEW SESSION, 1937-38.

THE beginning of the present session is accompanied by various unusual changes which were referred to by the Principal in his opening address to the staff and students and which, in view of their general interest, may conveniently be recorded here.

We deplore in the first place the severe losses through death suffered by our Governing Body. No fewer than five Governors, Sir James Currie, Sir Edward Davson, Sir Eliot de Pass, Sir Cecil Hanbury and the Hon. A. E. Collens have died during the past year. Sir James Currie, who first joined the Governing Body in 1922 as a representative of the Empire Cotton Growing Corporation, became Chairman in 1927, serving the College in that capacity for nearly ten years. Sir Edward Davson had represented British Guiana since 1924, Sir Eliot de Pass had been a co-opted member since 1925 and Sir Cecil Hanbury since 1921, while the Hon. A. E. Collens had represented the Leeward Islands since 1921. We have also lost through retirement Sir David Prain, who joined the Governing Body in 1921 as a representative of the Colonial Office, and who has been our Vice-Chairman since 1925, and Sir Frederick Clarke who has represented Barbados since 1926. We welcome Mr. Eric Macfadyen, who has been appointed Chairman of our Governing Body. Because his interests have been largely concerned with plantation crops in the East, his outlook towards scientific agriculture has always been most sympathetic, and we may therefore rely on him to do his utmost to insure that our various activities will continue uninterrupted. Sir Albert Seward, F.R.S., late Professor of Botany at Cambridge University has been nominated to represent the Colonial Office on our Governing Body and Mr. Douglas Pile is the new representative of the Barbados Government. Finally, Sir Leonard Lyle has been selected to represent the sugar industry.

The ranks of the College staff have also been severely depleted by the untimely deaths of Dr. H. R. Briton-Jones, Dean and Professor of Mycology, and of Mr. F. W. Urich, who had been Assistant Professor of Zoology at the College for many years. In addition, two senior members of the staff have left us: Dr. D. W. Duthie has joined the British Guiana Department of Agriculture as Agricultural Chemist, and Mr. N. Wright has been appointed as Botanist

to the Rubber Research Institute of Malaya. Both these officers rendered valuable services to the College during their periods of office and we take this opportunity of extending them our best wishes in their new spheres of activities. The vacant post of Dean of the College has been filled by Mr. G. G. Gianetti, while Mr. R. E. D. Baker has been placed in charge of the Department of Mycology. The new appointments on the staff include Dr. E. C. Humphries as Lecturer in Chemistry, Dr. K. S. Dodds as Lecturer in Botany, Mr. McC. Callan as Lecturer in Entomology, Mr. H. S. Crowdy as Lecturer in Mycology and Mr. F. S. Cope as Botanist for Cacao Research. The latter will work with Mr. O. J. Voelcker who is returning to Nigeria next year in order to resume his activities in the Nigerian Department of Agriculture, from which he was seconded. Mr. R. G. Fennah has been seconded for special duty under the Government of the Windward Islands as Citrus Entomologist.

It is regretted that it has not yet been possible to strengthen the staffs of the Economics and Sugar Technology Departments of the College. The need for additional staff in both these departments has been recognised by the Governing Body but hitherto the necessary financial support has been lacking. At the moment the outlook for the Department of Sugar Technology in this respect is, however, much more hopeful as the sugar interests have definitely promised to contribute the necessary funds in order that the research activities of the Department may be extended. It is possible also that ways and means will also be found in the near future to strengthen the staff of the Department of Economics, especially if its work is to be extended in the British Caribbean area as at present contemplated.

We are once again able to record that the number of students attending the Diploma course has been maintained. Of these students, 25 come from the British West Indies and British Guiana, one from Guatemala, one from the Seychelles and one from India. There has also been an increase in the number of Agricultural Colonial Office Scholars, while one student has been selected this year for training by the Empire Cotton Growing Corporation. Two scholars from the Gold Coast Government, both graduates of the University of California, are also in residence, and will take the Associateship course. There has been a general tendency during the past few years for students from all parts of the Empire to attend courses at the College. In this connection, it may be mentioned that the Governments of Nigeria, Malaya and the Gold Coast have recently drawn up schemes for the training at this institution of a few selected members of their native staff who show exceptional promise. These schemes have been approved in principle by the College authorities, but the details of the courses of studies to be followed still remain to be worked out. Finally, we are glad to learn that the Sudan Government has definitely established an agricultural scholarship scheme based on that which has proved so successful for the Colonial Office and the Empire Cotton Growing Corporation. Two scholars who have already been selected under this scheme are at present at Cambridge University, and will proceed to Trinidad next year. We understand that the intention is to appoint two scholars each year for at least the next five years.

Turning to research, steady progress has been made during the past session and some of the results of the useful work done by the various departments of the College have been published from time to time in these columns and in other publications which we have issued. The consistent increase year by year in the commitments of the College as regards teaching, research and advisory work undoubtedly indicates that its existence has been justified, and that it has established its claims to wide recognition throughout the Colonial Empire. It is unfortunate, however, that the provision of the necessary funds to achieve its aims and objects has always proved such a difficult problem. It is very important that our annual revenue which, at present, is almost entirely dependent on contributions from Governments, from corporations and firms interested in tropical agriculture, should at least be maintained if not increased to meet our numerous obligations. It is much to be hoped, therefore, that apprehensions regarding the continuity of the revenues necessary for the research work of the College will in the future be removed.

The Late D. P. S. DELGADO.

It is with deep regret that we have to record the death of Mr. D. P. S. Delgado which took place in the Westminster Hospital, London, on 26th September. Douglas Delgado was 21 years of age and a Jamaican by birth. He joined the College in October 1936 as a first year student and last June successfully passed the First Year examinations for the Diploma. His happy disposition earned him many friends and made him a deservedly popular student. By his death a career which showed definite promise has been cut short and our deepest sympathy goes to his family in their great loss.

The second edition of Professor R. C. Wood's "Note Book of Tropical Agriculture" has just been published. It contains information on weights and measures, mensuration and surveying, buildings and roads, machinery, labour, soils, manures, crops, foods and feeding, livestock, dairying, recipes, statistics, current prices and Imperial Agricultural Institutes and Bureaux. Copies (price five shillings, post free) may be obtained on application to the Editor, *Tropical Agriculture*, Imperial College of Tropical Agriculture, Trinidad, B.W.I.

THE PHYSICAL ENVIRONMENT, FAUNA AND AGRICULTURE OF THE BRITISH SOLOMON ISLANDS.

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(*Continued from Tropical Agriculture*, XIV, 10, 1937).

Entomology.

General accounts of the insect pests have appeared elsewhere (1 and 21) and about 100 species found in various parts of the coconut palm have been treated in the local Agricultural Gazette (32). The insect fauna is Austro-Malayan, with a distinct Australo-Fijian affinity in the Santa Cruz Islands. Introductions made by European shipping are many and include representatives from the chief orders. *Periplaneta australasiae* F. among the Orthoptera has no native name ; the moths *Ephestia cautella* Wlk. and *Corcyra cephalonica* Stt. are common on ships, but it is among the beetles that there are most introductions. Examples are : *Tribolium castaneum* Hbst., *Carpophilus dimidiatus* F., *Araecerus fasciculatus* De Geer, *Necrobia rufipes* De Geer (which breeds in uncared-for copra-driers) and *Oryzaephilus* (*Silvanus*) *surinamensis* L., which, with *Tribolium*, has arrived in rice and flour from Sydney, N.S.W. Among the Hymenoptera there has been much colonisation by ants ; *Pheidole oceanica* Mayr. and *Iridomyrmex myrmecodiae* Emery are two of the most successful, although the latter is still confined to the eastern islands of the Protectorate. Lastly, the flies ; *Musca vicina* Macq. has come in since 1911 (21), while the buffalo fly *Lyperosia exigua* de Meij. arrived *via* New Britain in the early twenties. The date of the arrival of the stable-fly *Stomoxys calcitrans* F. will probably never be known.

Far less data about local insects are available than for other Pacific islands such as Hawaii, Marquesas, Samoa and Fiji. A review of the more interesting members of the chief orders is, however, given, though new genera and species are constantly being received from the Imperial Institute of Entomology.

Orthoptera.—Among the larger Acrididae are new species of the following genera : *Bumacris*, *Cranaë*, *Modernacris*, *Opitacris* and *Austacris*, while descriptions of the following pigmy locusts or Tettigidae have recently been made in Germany : *Hyboella*, *Thyrsus*, *Paratettix* and *Euparatettix*. The most interesting of these is *P. macrophthalmus* Gün., which has been taken at a height of 1,000 feet on Kolombangara and on boulders in streams at the same elevation on Guadalcanal. Newly described Phasmidae are *Phasma*, *Phasmotaenionema*, *Chondrostethus* and *Leprocaulus*. The Mantidae are well represented and *Tenodera costalis* Blch. suffers parasitism from a species of *Podagrion* (Torymidae) with a very long ovipositor adapted to reach the eggs in the thick spongy oötheca. The Gryllidae are represented by the mole-cricket *Gryllotalpa africana* P.B., a genus said by Buxton (33) not to occur in the Solomon Islands.

Dermaptera.—Besides the almost tropicopolitan *Chelisoches morio* F., another species of this genus has been described from New Georgia and a species of *Marava* from Bougainville to the north-west of the Protectorate.

Isoptera.—Termites have been dealt with in some detail elsewhere (34) ; the most harmful is *Coptotermes grandiceps* Snyder, which is the white ant against which buildings have to be insulated. An instance of a curious introduction was a chair made from a canoe and found to be infested with *Calotermes* (*Cryptotermes*) *buxtoni* Hill. The crew of this canoe was blown over 300 miles out of its course from either Laughlan or Woodlark Islands in the D'Entrecasteaux Archipelago. Previous records of this insect are Fiji, Samoa (also introduced in both cases) and Thursday Island in the Torres Straits—a peculiar distribution.

Embioptera, Ephemeroptera and Psocoptera occur, but none has been identified ; probably the first is a species of *Oligotoma*.

Anoplura.—Among the bird-lice or Mallophaga are *Eumenopon denticulatum* Harr. from the red lory (*Eos*) and *Columbicola columbae* L. from the fruit-pigeon (*Ducula pistrinaria*) ; both records are from north Guadalcanal. In the sub-order Siphunculata is *Pediculus humanus* L., which must be accounted a native introduction. The dragon-flies include the scarlet-winged *Neurothemis terminata* Ris. and the hyaline *Diplacodes trivialis* Ramb. Several species of thrips are known, of which *Dinothrips sumatrensis* Bag. is up to 9 mm. in length and shows its range in the specific name.

Rhynchota. — This richly-represented but poorly-identified order has many forms of Ricaniidae and Flatidae. Two new species of the Membracid *Otinotoides* have recently been described and the Cercopidae await similar treatment.

A widely ranging species is the Lophodid *Lophops saccharida* Kirk., found in Queensland on sugar and grasses. Whether this was introduced from Australia by returned kanakas prior to 1903 (when this system of recruiting ceased) is not easy to say. It has certainly established itself now and is to be taken on low herbage. Two species of cicadas are commonly found, *Diceropyga* and the smaller *Baeturia* : Myers (35) gives *Heteropsaltria*. The scale-insects are not normally serious pests ; *Chionaspis citri* Comst. attacks oranges and *Pseudococcus cocotis* Mask., *P. leveri* Green and *Heterococcus painei* Laing occur on coconut leaves.

Among the Heteroptera, the Coreid *Mictis profana* F., found only in the Santa Cruz Islands in the Solomons, has previously been mentioned as occurring also in Queensland and Fiji. *Amblypelta cocophaga* China causes immature nutfall of coconut (38) and *A. gallegonis* Lever seems confined to Isabel Island, where it has been taken on cassava and *Codiaeum* (36). Also in this family is *Leptoglossus membranaceus* F., which is a pest of tomatoes and ranges from South Africa to the Philippines and Queensland. The Pentatomid *Axiagastus cambelli* Dist. was incriminated by Tothill (13) as the cause of nutfall, but the present writer has found it numerous on good-bearing trees and is unable to regard it as primarily responsible. Four species of cotton-stainers are recorded, of which *Dysdercus sidae* Montr. is a pest on cotton and kapok. *Cimex hemipterus* F. is, perhaps, more likely to be a European introduction than *Pediculus*, but data are lacking on the date of its arrival. The small Capsid *Engytatus tenuis* Reut., found in India and Japan on tobacco, is present on Sikaiana Atoll.

Few Neuroptera have been identified; *Notochrysa* and species of Myrmeleontidae and Mantispidae are known among the Planipennia.

The Lepidoptera well shew the Austro-Malayan nature of the fauna, some having a very wide range; the Arctiid *Deiopeia pulchella* L. is a common moth on the littoral tree *Tournefortia* and is known as the scarce speckled footman, among British lepidopterists. The smaller moths, especially of the families Lyonetiidae, Heliodiniidae and Cosmopterygidae, are regularly described in Mr. Meyrick's "Exotic Microlepidoptera". Included among the Pyralidae is *Tirathaba rufivena* Wlk., whose caterpillars bore into young coconuts. Its range is very great, as Paine has shewn it occurs across Asia from Ceylon to New Caledonia and Queensland (37). The larva of the banana scab moth *Nacoleia octasema* Meyr. does some injury to the fingers of this fruit and, like *Tirathaba*, is parasitized by a Braconid *Apanteles* (38). Other caterpillar pests are the Sphingid *Hippotion celerio* L. on taro and the Noctuids *Prodenia litura* F. on tobacco and *Desmodium* leaves and *Phytometra chalcytes* Esp. on tomato. The males of various species of Euploea are attracted to dead leaves, boughs and flowers of *Tournefortia argentifolia* L. (33 and 40). The Papilionidae, though somewhat less spectacular than those from New Guinea, are very bright. At least one species of *Ornithoptera* (*Tröides*) extends to San Cristobal (16), although this was denied (18). Sexual dimorphism of colour is carried to an extreme in *O. priamus d'urvillianus* Guér., where the male is metallic blue with a sulphur-coloured body and the female a dun brown, though having a wing-span of eight inches.

COLEOPTERA.—Some of the recent introduced species have been mentioned earlier. Five genera of the Cicindelidae [a family absent from Samoa (33)], are recorded, of which *Tricondyla aptera* Oliv. and *Therates labiata* F. are found 2,000 miles to the westward in the Kei Islands (15). Another difference from such an oceanic fauna as Samoa is seen in the number of leaf-eating Curculionidae, of which *Rhinoscapha* and *Trigonops* are two abundant genera in the jungle. Among aquatic beetles, the large *Cybister* and the smaller *Hydaticus* occur, while the small *Platynectes spilopterus* Germ. has been taken in hill-streams in the small island of Santa Ana, San Cristobal. The leaf-eating Lycidae have recently received attention and new species have been described among the following genera: *Cladophorus*, *Trichalus*, *Flabellotrichalus*, *Leptotrichalus* and *Metriorrhynchus*. Similarly among the Elateridae, new species have been named in the genera *Alaus*, *Adelocera*, *Anchastus*, *Conoderus*, *Dioxypterus*, *Melanoxanthus*, *Melanotus*, *Propsephus*, *Sphenomerus*, *Simodactylus*, *Neodiploconus* and *Symphostethus*. The bark-frequenting Buprestidae give a typical Australasian appearance to clearings in the jungle and a new species of *Paracupta* and *Sambus* have been described. One of the most injurious insects in the Solomons is the Hispid *Brontispa froggatti* Sharp, whose damage to the leaves of coconut (21, 32, 38) is being controlled by the introduction of the Eulophid *Tetrastichodes brontispae* Ferr., introduced from Celebes to Java and sent thence by air mail to Queensland and by ship to the Solomons whence it was liberated in September, 1936. Several species of palm-eating *Promecotheca* are known; the economically important *P. opacicollis* Gestro of the New Hebrides is found in the Santa Cruz Islands, where it is parasitized by two Hymenoptera mentioned later. The Curculionidae are abundant but poorly known; a new genus has been erected for a weevil 2 mm. in length found on male coconut flowers, viz.: *Meredolus*, very similar to *Derelomorphus* found in the same ecological niche in Malaya. The red weevil, *Rhynchophorus schach* Oliv., breeds in the pithy trunk of the ivory nut palm (*Metroxylon*). Among the Dynastids, *Scapanes grossepunctatus* Sternb. is to be added to *Trichogomphus* and *Xylotrupes* previously recorded from the coconut palm (1, 21). The metallic Cetoniidae are represented by the widely-ranging *Lomaptera* and *Ischiopsopha*, which frequent coconut inflorescences, especially the staminate flowers.

HYMENOPTERA.—This order is rich both in numbers of individuals and in species, but is poorly described as yet. The brilliant Chrysidae, absent from Samoa (33) are represented by *Stilbum*, *Chrysis* and *Hexachrysis*. The Braconid *Apanteles tirathabae* Wilk. is parasitized by the polyembryonic *Calliceras fijiensis* Ferr. and *A. ruficrus* Hal. parasitizes Noctuid larvae in the Santa Cruz Islands. This group has also the Trichogrammatid egg-parasite of *Promecotheca*, *Oligosita utilis* Kow. and the larval parasite *Closterocerus splendens* Kow. In addition to *Tetrastichodes*, mentioned before, another purposeful introduction is *Spalangia sundaica* Grah., sent by aeroplane for 1,500 miles from the Northern

Territory across Queensland to Brisbane and thence another 1,500 miles in a ship's cooler to the Solomons, where it was liberated on Guadalcanal Island in June, 1936. Workers and soldiers of the non-endemic ant *Pheidole oceanica* Mayr. infest every cake of cow dung into which the female *Spalangia* penetrates in her search for *Lyperosia* pupae. As the ants were able to seize the parasites, they had to be removed from the dung before the 2,000 *Spalangia* could be liberated. Eggs of the Coreid *Amblypelta* are parasitized by *Anastatus axiagasti* Ferr., which, with the Scelionid *Microphanurus painei* Ferr., also attack those of the Pentatomid *Axiagastus cambelli* Dist. The Torymid *Podagrion* has been referred to above as parasitizing the oötheca of the Phasmid *Tenodera*. The ants occurring in the Protectorate are not yet all described; Mann (17) gives details of 43 genera and 144 species, but says that, apart from some ants taken from the interior of Malaita, the ant-fauna of the mountains is absolutely unknown. The replacement of endemic forms by introduced species is severe and the absence of the typical local arboreal species at the coast and in plantations and villages is well-marked. The abundance of *Pheidole oceanica* Mayr. was mentioned before; another example is *Plagiolepsis longipes* (Jerd.) which has been found by the writer nesting in a box full of rock-specimens and again in a carton containing nothing but boiled linen bandages. This ant never seems to occur away from human settlements. The small island of Bellona (Mungiki) to the north-west of Rennell has a new genus—*Willowsiella*—found in 1933 by an American party. The Mutillidae or velvet ants of the Solomons well show the extent of former land-connexions. From New Guinea arrived *Timulla* (*Trogaspidia*) *oceanica tulagiensis*, while the same area was entered by *Ephutomorpha pagdeni* from Australia which was again separated from the Solomons (39).

DIPTERA.—Only the Culicidae have been named with much thoroughness. There is but one anopheline, *Anopheles punctulatus* Dön., and it extends from New Guinea to the New Hebrides. Paine (*see* 1, 21) says of this that "the early stages are found for the most part in very small areas of water of a purely temporary nature such as . . . in hoof marks", but the writer has bred the adult from larvae taken in an extensive and apparently permanent swamp on Malaupaina, Three Sisters. Buxton (33) gives a useful table of all the sub-genera known from the Solomons, but omits the following: *Armigeres*, *Lutzia*, *Rachinotomyia*, *Mansonioides*, *Rachiosoura* and *Culiciomyia*. An interesting case of colonization is *Aëdes samoana* Grünb., native to Samoa and Tonga, which has been found in Roviana, New Georgia (33) and Malaupaina, Three Sisters (33b). The arrival at the first locality is thought by Buxton to be due perhaps to Tongan mission teachers bringing in taro plants in whose axils were eggs of this mosquito. He also shows that *Aëdes scutellaris* Walk. (*variegatus* Dol.) is the vector of filariasis in Samoa; the variety *tongae* is found in Sikaiana and var. *hebrideus* in Rennell and Santa Cruz (28). Its favourite breeding place is split coconut husks and its assumed arrival in Sikaiana with colonizing Polynesians from Luahatu (*see* above under "Mammals") shows its ability to withstand immensely long voyages, even if allowance is made for occasional drenching with rain-water in the canoes. Two differences from the fauna of Samoa (33) are the presence in the Solomons of large and robust Tipulidae and the sand-flies Ceratopogonidae. The latter family is represented by *Leptoconops* (*Styloconops*) *albiventris* Meij., though it seems that the two southern islands of the Three Sisters have different species. In the Brachycera, several new species have been described from the Stratiomyidae, viz. *Microchrysa*, *Geosargus*, *Hermetia*, *Evaza*, *Ptelicus* and *Sargus*. The same applies to the Dolichopodidae where, besides new locality records, species have been described by the Abbé Parent from the following genera: *Chrysosoma* (13 species), *Sciopus*, *Diaphorus*, *Dolichopus*, *Megistostylus*, *Paraclius* and *Neurogona*. The state of taxonomy is so chaotic among the Calypterae that what one authority (Townsend) refers to as the family Calliphoridae is by another (Baranov) accepted as the Tachinidae. Two large flies, 15 and 20 mm. long respectively, are *Chrysosarcophaga superba* Towns, and *C. magnifica* Baran, and they range from Bougainville to Guadalcanal. A new genus—*Leverella*—has been erected for a fly which extends into New Guinea; other new species are in *Bactromyia*, *Doleschella*, *Athyrsia*, *Lioproctia*, *Erycia*, *Phorocerosoma*, *Formosia*, *Cuphocera*, *Eurystaea* and *Paratricyclea*. The local house-fly, *Musca vicina* Macq., may be only a local race of *M. domestica* L. and, like *Lyperosia*, previously mentioned, breeds in cow dung. The latter fly is believed to have arrived prior to 1922 with cattle exported from New Britain to Bougainville Straits. Among the Pupipara, three Nycteribidae from bats on Isabel and Russell Islands have been described (16) and a new Streblid, *Nycteribosca minuta* Jobling, has been taken from a small bat on one of the latter islands.

Crustacea.

Only a few of this large class has been collected. Among crabs are *Gelasimus* and *Sesarma*; *Petrolisthes* and *Remipes* in the Anomura and among the prawns *Leander* and two species of *Palaemon* from rivers and mountain streams. Among the Isopoda are *Cubaris*, *Ligia hawaiensis* on stones and coral near the high-water mark and probably a new species of *Argathona* from a marine fish on which it is an ectoparasite. These identifications are made by Dr. I. Gordon of the British Museum.

Arachnoidea.

Only three scorpions are recorded, viz.: *Isometrus maculatus* Geer, *Hormorus australasiae* F. and *H. caudicula karschi* Keyserling.

Specific identifications of only two spiders have been received; both are brilliant and have the gaster produced into long sharp spines: *Gasteracantha* (*Octinacantha*) *scintillans* Butl. and *Tetragnatha keyserlingi* Simon.

Often found associated with the Hispid *Brontispa* is a small mite which is either *Celaenopsis* or *Anoplocaeleno*. Longicorns and Passalid beetles have as ectoparasites both *Uropoda* and *Trichocylliba*. For all these identifications I am indebted to Dr. S. Finnegan of the British Museum.

New species of Pseudoscorpionidea have been described (24) by Mr. M. Beier of Vienna as follows: *Xenolpium salomonis*, *Paratemnus salomonis* and *Parachernes insularis*, all from Rendova Island.

Mollusca.

Freshwater shells were collected by Guppy in the 'eighties, but he mentions (14) that much still remains to be done. The island of Santa Ana (Owa raha), though only 2½ miles in length, had 4 new species of *Helix* and *Melanaria* out of 11. The order of frequency given by Guppy was *Neritina*, *Melania* and *Navicella*. Endemicity is very high in the small islands off the coast of San Cristobal and in a bed of loam on this island Guppy found forms now extinct there but still living on Guadalcanal and Shortland Islands (2, 16). *Batissa* is a common fresh-water mussel.

Of terrestrial species, the Stenogyrid *Sublina octona* Brug. has been taken by the author in leaf-mould. Germain (25) lists 33 species of *Placostylus* and *Partula* from the Solomons proper and 32 from Santa Cruz. The Louisiades to the west and New Hebrides to the south-east have respectively 36 and 30 species.

Some of the marine species are of economic importance: thus *Trocas niloticus* is annually exported to the value of some £25,000, while green snail (*Turbo marmoratus*) represents about £2,000. Some black lip (*Margaritifera*) is also exported.

Vermes.

This convenient if archaic term will include the Nematoda which are common in the eyes and intestines of hawks and herons. The following identifications are by Dr. H. A. Baylis of the British Museum: *Thelazia aquilina* Baylis, *Porrocaecum angusticolle* Molin., *Physaloptera alata* Rud., a species of *Habronema* and *Contracaecum microcephalum* Rud. Another Ascaridae is *Ancylostoma*, which causes much hookworm among the natives. Buxton (9) quotes Lambert to show that this round-worm was introduced by Asiatics, whereas in New Guinea and Oceania the indigenous genera are *Necator* and *Trichuris*.

The author has taken the Cestode *Raillietina carpophagi* Joyeux & Hondemer from the pigeon *Globicera rufigula*.

Flora.

The flora is said by Guillaume (25) to show a predominance of Leguminosae, Rubiaceae, Euphorbiaceae and Urticaceae, and of 137 species only 32 are endemic, without a single endemic genus. This shows how close has been the former connexion with New Guinea where the flora is so similar. By contrast, the oceanic island of Samoa has more than 30 per cent. of its plants peculiar to it (9).

A representative collection of the flora was made in Bougainville Straits by Guppy in 1884 and he gives (14) good descriptions of the characteristic forms found in the high jungle, river-banks and the coasts of the smaller islands. The part played in the distribution of seeds by the Nicobar pigeon *Caloenas* is rightly stressed.

Orchids, always a popular group with botanists, were collected in New Georgia and Bougainville by Mr. H. L. Waterhouse; identifications of 32 genera and 45 species were made at Kew (26). As these were collected over a period of four years, it is unlikely that there are many undescribed forms, as there is a thinning off in practically all plants and animals as one goes east from Bougainville.

The author has sent specimens of Pteridophytes from various islands to Mr. A. H. G. Alston of the British Museum, and forms occur with as wide a range as Africa to eastern Polynesia. Among the Lycopodinae are 6 known species of *Selaginella*, among which is *S. poperangensis* Hieron, whose range has been extended over 400 miles, from the Shortlands to Ulawa. A hairy-stemmed form from Isabel and the Russell Islands has yet to be described. *Lycopodium squarrosum* Forst. from Polynesia and the New Hebrides (27) is also in the Solomons. Among the Filicinae are at least four species of the alga-like *Trichomanes*, of which *T. humile* Forst. extends as far as Sumatra.

The prairie country of Guadalcanal has two dominant grasses. *Themeda australis* (Kangaroo grass) and lalang (*Imperata cylindrica*). Both are very coarse grasses and give a deceptive appearance to the plains and foothills, which seem at a distance to be clad with turf reminiscent of the South Downs (Fig. 3).

Many plants introduced accidentally have flourished so as to rank now as weeds. Common examples are: *Sida* (two species), *Mimosa pudica*, *Ageratum*, *Chrysopogon*, *Desmodium* (two species), *Clidemia hirta*, *Asclepias*, *Triumfetta*, *Polygale* and *Stachytarpheta*. Wilfully introduced plants are *Lantana*, *Eichhornia crassipes*, *Psidium guajava*, which, with *Stachytarpheta*, are declared noxious weeds. It will be noticed that the bulk of these plants are of South American or Australian origin.

An undescribed species of entomophagous fungus, *Hymenostilbe*, has been found on Ulawa growing on Ortalid and other flies. A species of *Corticium* (*Corticium penicillatum* Petch) causes thread-blight of coconut leaves.

Excluding such economic crops as yams, taro (eddoes), tobacco, banana and sweet potato, the most interesting local plant is the ivory-nut palm, *Metroxylon solomonense* Becc. The hard mesocarp is exported whole and is the source of the so-called "vegetable ivory". Only in the

western end of the Group was the pith used as food by the natives (14, 18), the eastern ones merely utilizing the leaves as roofing material. The extraction of the sago-like pith was carried out by straining it through the fibrous leaf-stipule of the coconut palm and allowing the heavy grain to settle in crude bark troughs. In the isolated Santa Cruz district, the fluted leaf-butt is said to be used in place of a trough. Later, the mass is made into cakes which are baked so as to keep; flour, however, is not prepared from it.

Another plant of restricted distribution is the Fiji or Queensland arrowroot (*Tacca pinnatifida* Forst.), the staple food of the Polynesians of Tikopia, a small island 125 miles south-east of Vanikoro in the Santa Cruz group. Elsewhere in the Solomons this plant does not seem to be used at all, though the Tikopians are so addicted to the tubers that they refused to touch rice when first given it, though this has long been the mainstay of Melanesians in European employment.

The seeds of various species of screw-pine (*Pandanus*) are used as food and the Polynesians of Sikaiana make mats and baskets from the leaves. Guppy (14), quoting Scherzer's voyage of 1861-3, gives the native name as "dawa", but the present writer found the inhabitants of this atoll call it "tehala."

The resinous nut of the rosaceous *Parinarium laurinum* A.Gr. is, when mixed with earth and pounded, used for caulking the seams of canoes; this nut resembles in size and shape a hard potato. As shewing how little agreement there is in Melanesian names on different islands, or even in different districts on the same island, it may be mentioned that this nut is called "tita" in the Shortlands, Guadalcanal and Nggela; "muki" on Isabel and parts of Malaita; "sai'a" and "rai'a" on other parts of Malaita and "bulu" on San Cristobal.

The capitalistic crops have been dealt with elsewhere (1, 21) and so will not be fully treated here. The tung tree, *Aleurites fordii* Hemsl., has failed wherever it was tried in the Solomons and it seems that *A. montana* E. H. Wilson would be better. Rice is grown on two mission stations on Guadalcanal and San Cristobal and so saves paying freight from Sydney on this cereal, which forms an essential part of the native ration, one pound per man per day. Vanikoro Island, Santa Cruz exports kauri pine (*Agathis macrophylla* Masters) to Melbourne, Victoria. Other species are found in New Caledonia, Fiji and New Zealand but not outside the Santa Cruz Islands in the Solomons, so that these last shew a kinship with the Melanesian (*sensu stricto*) region to the south and east (17). A species of *Calophyllum*, called "Island cedar" and used for coffins, is exported from the Shortlands. The total annual export of all timber varies from 735,000 to 1,870,000 super. feet. Three local trees provide termite-resistant wood used for houses and fences, viz.: *Intsia* (Leguminosae), *Guetterda* (Rubiaceae) and *Phyllanthus* (Euphorbiaceae).

Several plants which do not provide food can next be considered. The areca palm (*Areca catechu* L.) yields the kernel of the betel nut, though actually it is the leaf of a pepper, *Piper betle* L., which should have this name. The nut and leaf are chewed with powdered coral and stains the saliva red. Lambert (28) mentions that the people of Bellona (Mungiki), who are addicted to this masticatory, have blackened teeth, while the inhabitants of Rennell (Mungava), only 15 miles distant and of the same stock, do not chew this nut and have in contrast fine white teeth. Groves of this palm are found near most villages in the Solomons and their ownership is zealously guarded. Several species of derris are used for killing sea fish; no effect seems obtainable against fresh-water fish in the much colder rivers and streams. One local form used is *Deguelia trifoliata* Lour. (=*D. uliginosa* Benth.); the roots of a species found on Tulagi, Savo and Gizo were found to have the greatest toxicity of any local forms, but the Rothamsted Experimental Station proved them to be only one-sixth as effective as the commercial species from Malaya (29).

Agriculture.

Prior to the permanent European occupation in the 'seventies, some structural agricultural devices were in use among the natives. Excellent irrigation terraces can be seen on western Guadalcanal at a height of 1,000 feet and taro is still grown in them, though the terraces are neglected. Similar structures are found in Kolombangara, Malaita, New Guinea and New Caledonia (30).

A methodical way of lining out ground for planting taro has been seen by the writer at Savo. Lengths of the aerial stems of *Calamus* are laid in straight lines down the hillside to be planted and then others at right angles; the tubers are planted where the two systems intersect. In Sikaiana Atoll, this crop is planted in swamps on raised beds of rotten leaves and mould built up into ridges by the women. Santa Cruz must be the extreme western limit of what is known as kava culture, *i.e.*, the preparation of a beverage from the giant pepper *Piper methysticum* Forst. This plant is used throughout Polynesia, New Hebrides and Fiji (where it is called "yangona", often written "yaqona") and has a mild narcotic effect when fresh, but is intoxicating if kept.

Estate agriculture, as distinguished from native, is not at a high level. Coconut palms are believed to be virtually immortal and not in need of either manuring or cultivation. Sporadic attempts at disc ploughing, rotary hoeing and an occasional application of blood and bone were all that one met with until recently, though now a well laid-out manurial trial of plots divided into Latin squares is in progress (31) on two islands. The usual planting distance for coconuts is 27 feet square or quincunx, but some 24 and 30 feet plantings are also found. Cover cropping is rare, but *Calopogonium* and *Pueraria* are used in a few places.

Except perhaps for kapok, it is unlikely that any other crop will be grown on a large scale, as the planting community has sunk capital in expensive steam or hot-air driers and bagging sheds for the curing and storing of copra. Smaller planters have smoke-dried kilns and are also wedded to this product.

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RICE FERMENTATION.

Alcoholic fermentations fall into three groups: (1) the direct inoculation of the fruit juice by yeast as in wine production; (2) the fermentation of a grain extract after pre-treatment as the malted grain in beer; and (3) the re-inoculation of a partially cooked plant material. Rice as a source of alcohol has had to be approached from this third angle by K. Rami Reddi and Dr. V. Subrahmanyan, of the Indian Institute of Science, Bangalore, who have published a most interesting paper upon 'Sonti' fermentation (*Trans. Nat. Inst. Sci., India*, 1, No. 11, 1937), which describes and analyses traditional methods of rice fermentation handed down from father to son, often as secret customs in small village communities, and then gives a preliminary estimate of their biochemical and biological basis. The 'Sonti' fermentation is practised in certain districts of the Madras Presidency. The main organism associated with the process appears to be a hitherto undescribed species of *Rhizopus* provisionally named *Rhizopus Sontii*. It is allied to *R. cambodia*, but its physiological activities are more pronounced. Indeed *R. Sontii* may have a practical future before it as it liquifies and saccharifies cooked rice more rapidly than other well-known organisms, including *Aspergillus oryzae*. This paper is fascinating in its linkage of tradition with modern problems of biochemistry and mycology, and it shows the great possibilities of advance in standards of nutrition as the result of scientific study of methods of food preparations that are acceptable to a conservative native population. Studies of the species of *Rhizopus* isolated from Chinese yeast cakes such as are used in brewing alcohol from cereal grains in China, Manchoukuo and Korea are also being extensively carried out by M. Yamazaki, professor of zymology (*Bull. Utsunomiya Agric. Coll.* A.2, No. 6, 1937). —(*Nature*, Vol. CXL, No. 3531, pp.33-4, 1937.)

THE BORING POINTS FOR REFRACTOMETER TESTS OF SUGAR-CANE.

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The Zeiss Refractometer has been adopted in British Guiana for the purpose of testing sugar-cane fields prior to harvest, and of guiding the selection and discarding of seedlings at the cane-breeding station. Under the latter conditions it was soon found that while the coefficient of correlation was high between the brix of expressed juice and the total solids as determined by refractometer readings on composite samples from borings made in the top, middle and bottom thirds of the stalks, the absolute values did not correspond as closely as was desirable. An investigation was therefore undertaken to determine if there was any fixed point or points in the stalk which would yield a refractometer reading identical, or nearly so, with the true mean brix of the stalk.

The work was carried out on plant canes of three varieties (P.O.J. 2878, Diamond 10 and D. 66/30) and in duplicate on each variety. The procedure adopted was to select from the same field of any one variety, five stalks having eleven internodes (joints), five having twelve internodes, five having thirteen internodes, &c., &c. On arrival at the laboratory, the tops (cabbage) of the stalks as far as the first joint below the point of attachment of the oldest green leaf-sheath were discarded. Then for each batch of five stalks the internodes were milled separately, *i.e.*, the five topmost (second) joints together, the five next joints together and so on until the bottom or older end of the stalks was reached.

The per cent. total solids in juice for each batch of joints was determined, and by noting the weight of the juice extracted it was possible to calculate a weighted mean total solids for the whole stalk. All that was then necessary was to note at which joint or joints the per cent. total solids corresponded with the mean figure for the whole stalk. The results obtained are presented in Table I and illustrated in Fig. 1.

It will be seen that in stalks of all lengths from fifteen to twenty-four internodes (joints) and of all three varieties tested, the per cent. total solids of the juice from the seventh or eighth joint below the point of attachment of the lowest green leaf-sheath (*see* Fig. 2) corresponds closely and consistently with the mean total solids of all the juice from the stalk.

In the case of the shorter (younger) stalks, having from eleven to fourteen joints, the location of the joint with the true mean total solids is somewhat higher up the stalk, *i.e.*, at the fifth and sixth joint below the point of attachment of the oldest green leaf-sheath.

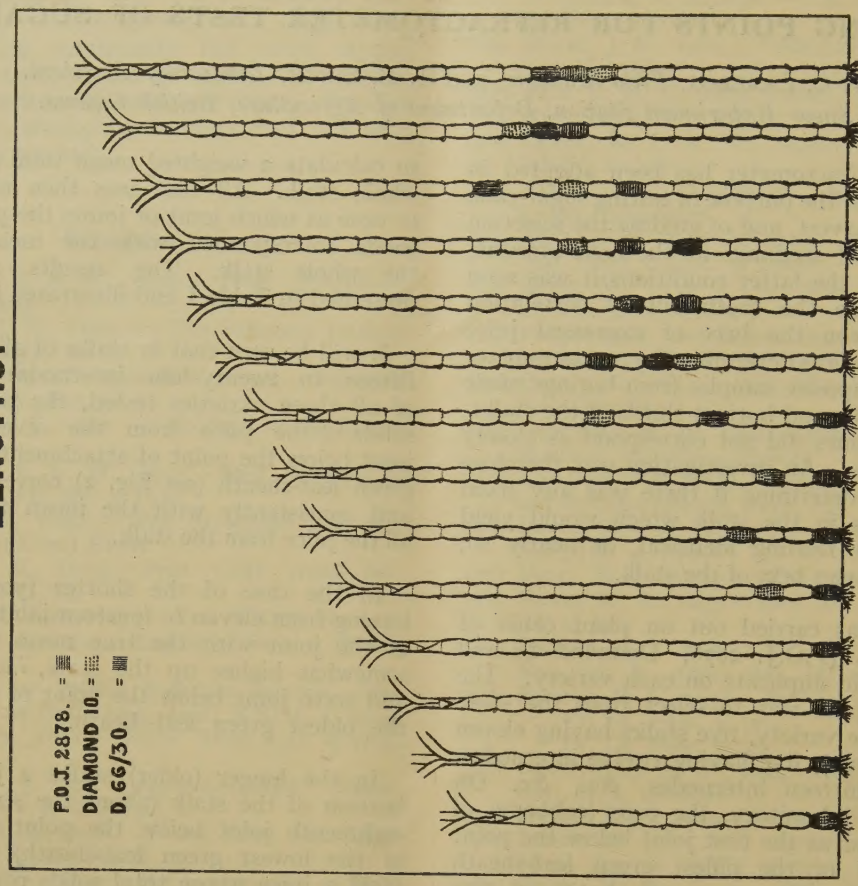
In the longer (older) stalks a joint near the bottom of the stalk (about the sixteenth to the eighteenth joint below the point of attachment of the lowest green leaf-sheath) also tends to yield a juice whose total solids corresponds with the mean for the whole stalk but the exact joint cannot be defined with as much accuracy as the higher one and does not appear to occur at all in the younger stalks.

Table II shows a typical set of readings for two groups of five canes. They show that the difference in total solids between the fifth and

TABLE I.

Location of Joints of Cane Stalks with per cent. Total Solids Corresponding to Mean Total Solids of Entire Stalk.

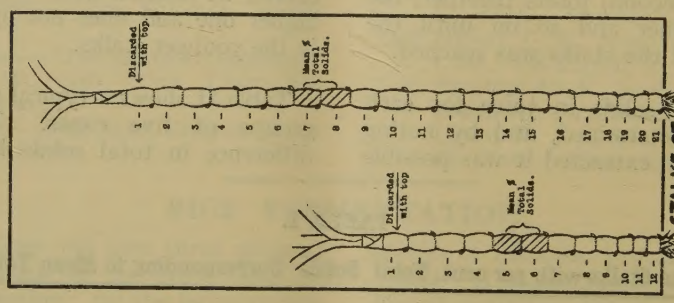
Stalk of	Number of Joint Below the Point of Attachment of the Oldest Green Leaf which may be Bored to Secure a Refractometer Reading Corresponding to the Weighted Mean Solids of the Whole Stalk.			
11 Joints	5.57	±0.19		
12 do.	5.83	±0.15		
13 do.	7.00	±0.25		
14 do.	6.25	±0.68		
15 do.	7.87	±0.28		
16 do.	7.28	±0.33		
17 do.	8.11	±0.53		
18 do.	7.75	±0.29		
19 do.	7.89	±0.35	16.7	±0.63
20 do.	8.89	±0.46	15.5	±1.06
21 do.	7.85	±0.60	18.0	±0.62
22 do.	7.25	±0.42	16.3	±0.61
23 do.	7.25	±0.76	17.0	±1.00
24 do.	8.14	±0.59	18.0	±1.17



LOCATION OF JOINT WITH HIGHEST % TOTAL SOLIDS IN STALKS OF VARYING LENGTHS.

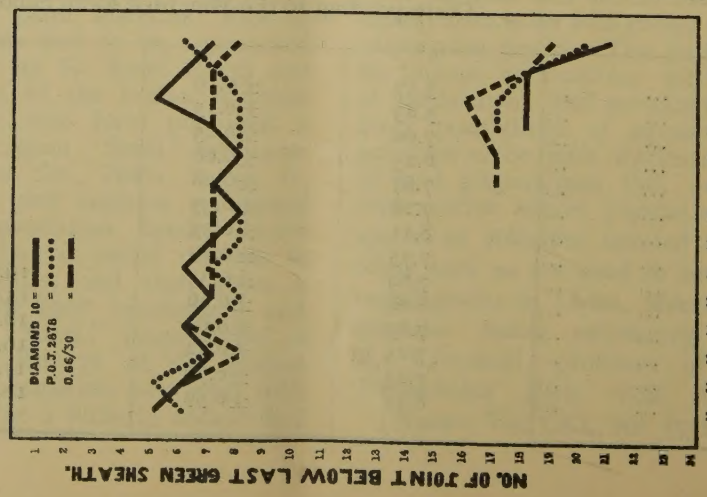
NUMBER OF JOINTS PER STALK.

FIG. III.



LOCATION OF JOINTS WITH MEAN % TOTAL SOLIDS.

FIG. II.



LOCATION OF JOINT WITH MEAN % TOTAL SOLIDS OF STALK.

FIG. I.

TABLE II.

Two Typical Series of Refractometer Readings.

Joint No.	Five 12-Joint Stalks of D.66/30.			Five 21-Joint Stalks of Diamond 10.		
	Refractometer Solids.	Total Weight of Juice from 5 Joints, lb.	Total Solids from Juice, lb.	Refractometer Solids.	Total Weight of Juice from 5 Joints, lb.	Total Solids in Juice, lb.
1	This Internode was discarded with top (cabbage).					
2	16.6	0.75	12.450	18.8	0.75	14.100
3	16.9	0.75	12.675	17.8	0.75	13.350
4	17.3	0.75	12.975	18.5	0.75	13.875
5	17.8	1.00	17.800	19.0	0.75	14.250
6	18.0	1.00	18.000	19.2	0.75	14.400
7	18.4	1.00	18.400	19.2	0.75	14.400
8	18.4	1.00	18.400	19.0	1.25	23.750
9	18.7	0.75	14.025	18.9	1.00	18.900
10	18.9	0.75	14.175	19.0	0.75	14.250
11	19.1	0.50	9.550	19.8	0.50	9.900
12	19.7	0.25	4.925	20.2	0.50	10.100
13	...	Total = 8.50 Weighted Mean Refractometer Solids = 18.04	Total = 153.375	19.8	0.75	14.850
14	...			19.8	1.00	19.800
15	...			19.6	0.75	14.700
16	...			19.8	0.75	14.850
17	...			19.6	0.75	14.700
18	...			19.2	0.50	9.600
19	...			19.4	0.50	9.700
20	...			19.7	0.50	9.850
21	...			19.8	0.50	9.900
					Total = 14.50 Weighted Mean Refractometer Solids= 19.26	Total = 279.225

sixth joints, or between the seventh and eighth joints is slight. Observers can therefore decide on a definite point (say the sixth joint for canes having from eleven to fourteen joints and the eighth joint for canes having from fifteen to twenty-four joints) and expect a reasonably high degree of accuracy in the results.

An investigation of this nature incidentally reveals what point of the cane stalk has the highest solids content. It was found that as far as the shorter canes (11 to 14 joints) are concerned, this is located at the base whereas in canes with longer stalks (15 to 24 joints) it tends to occur approximately in the middle of the stalk (*see* Fig. 3).

Summary.

An investigation to determine what joint or joints in a sugar-cane stalk had a total solids content corresponding with the weighted mean total solids of the entire stalk is described.

It is shown that under British Guiana conditions an accurate reading may be obtained from the fifth or sixth joint below the point of attachment of the oldest green leaf-sheath in the case of canes having from eleven to fourteen joints; and the seventh or eight joint, in the case of canes having from fifteen to twenty-four joints.

It is also shown that no corresponding joint with the mean total solids occurs in the lower (older) portion of the stalk of canes having from eleven to eighteen joints, but that such may be found in the canes having from nineteen to twenty-four joints. The location of this joint is, however, more liable to fluctuation, and observers may better rely on the joint with the mean total solids in the upper portion of the stalk.

Acknowledgments.

The writers are indebted to Mr. C. Holman B. Williams, Agronomist in Charge of this Station for his advice during the progress of the work and his suggestions with regard to the presentation of the results.

ADDITIONS AND CORRECTIONS TO THE FURTHER PRELIMINARY LIST OF TRINIDAD FUNGI BY C. A. THOROLD, 1931.

By R. E. D. Baker,
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Introduction.

It is now six years since the 'Further Preliminary List of Trinidad Fungi' by C. A. Thorold was published, and during this period many additions have been made. These are now published in the form of a supplement to the Further Preliminary List, and at the same time a number of corrections to this list, prepared by C. A. Thorold are appended.

The writer is indebted to the late Dr. H. R. Briton-Jones, to Dr. C. W. Wardlaw, and to Messrs. A. K. Briant, W. F. Steven and J. M. Waterston for many of the records, and to the Imperial Mycological Institute for some of the identifications.

PHYCOMYCETES.

OOMYCETES.

Albuginaceae.

Cystopus bliti (Biv.) de Bary.
Also on *Alternanthera ficoidea*, St. Augustine, 1933.

Cystopus ipomoeae-panduranae Farl.
Also on *Ipomoea sinuata*, St. Augustine, 1933, and on *Ipomoea pes-caprae*, Manzanilla beach, 1934.

Pythiaceae.

Pythium splendens Braun.
From roots of diseased citrus trees, 1936. *Det.* Imp. Myc. Inst.

Phytophthora palmivora Butler.
Also on citrus fruit; and causing gummosis of citrus trees, 1935. *Det.* Imp. Myc. Inst.

Phytophthora parasitica Dastur.
Also causing 'black shank' of tobacco, St. Augustine, 1934. *Det.* Imp. Myc. Inst.

Phytophthora sp. (*arecae-meadii* group).
Causing a pod-rot of cacao, 1935. *Det.* Imp. Myc. Inst.

ZYGOMYCETES.

Mucoraceae.

Mucor buntingii.
One of the cacao sweat-box fungi. A.K.B. 1932.

Choanephoraceae.

Choanephora cucurbitarum (Berk. & Rav.) Thax.
Parasitic on stems, leaves and pods of *Crotalaria sericea*, St. Augustine, 1937. *Det.* Imp. Myc. Inst.

ASCOMYCETES.

Erysiphaceae.

The *Oidium* stage of mildews of this family has been found on the following plants.

(Erysiphe polygoni ?).
On *Vigna sinensis* and *Phaseolus mungo*, St. Augustine, 1933.

(Erysiphe cichoracearum ?).
On *Cucumis melo*, St. Augustine, 1933; *Cucumis sativa*, St. Augustine, 1934; *Zinnia elegans*, St. Augustine, 1934, and *Hydrangea opuloides*, St. Augustine, 1935.

Sphaeriaceae.

Eutypella sp. (?*E. citricola* Speg.).
Perfect stage on dead wood of grapefruit trees; *Cytosporina* stage in culture. R.E.D.B., 1936. *Det.* Imp. Myc. Inst.

Botryosphaeria ribis Gros. & Dug. (*Dothiorella* stage only).
Causing fruit rots of avocado pear, citrus and cacao. C.W.W. & R.E.D.B., 1934.

Ceratostomella fimbriata (E. and H.) Elliot.
Causing wilt, and stem- and leaf-spots of *Crotalaria juncea*. A.K.B., St. Augustine, 1930. Also pod-rot of cacao, Montserrat district, 1935.

Ustulina zonata (Lev.) Sacc.
On dead wood, Tamana, 1936.

Sporormia minima Auersw.
From banana material, C.W.W.

Pseudoplea trifolii (Rostr.) Petrak.
A saprophyte found on bananas and grapefruit. C.W.W. *Det.* Imp. Myc. Inst.

Balansia trinitensis Cooke and Massee.
Also on *Chaetochloa sulcata*, very common, 1934.

Polystomellaceae.

Rhagadolobium cucurbitacearum (Rehm) Theissen & Syd.
Causing a leaf-spot of *Cucurbita pepo*. A.K.B., St. Augustine, 1932.

BASIDIOMYCETES.

Ustilaginaceae.

Cintractia leucoderma (Berk.) P. Henn.
On *Rynchospora* sp., W.F.S., Pitch Lake, 1934.

Pucciniaceae.

Puccinia panicicola Arthur.
On *Panicum barbinode*. St. Augustine, 1934.

MELAMPSORACEAE.

Coleosporium domingense (Berk.) Arthur.
On *Plumiera alba*. W.F.S., St. Augustine, 1933.

AURICULARIACEAE.

Septobasidium pseudopedicillatum Pat.
Saprophytic and weakly parasitic on grapefruit trees. H.R.B.J., 1933.

DACRYOMYCETACEAE.

Calocera viscosa (Pers.) Fr.
Saprophytic on damp wood, St. Augustine, 1936.

THELEPHORACEAE.

Corticium stevensii Burt.
Also causing threadblights on grapefruit and nutmeg.

Corticium sp.
Causing threadblights on *Warszewiczia coccinia*, *Ixora coccinia* and cacao.

AGARICACEAE.

Marasmius equicrinis Mull.
Also on *Coffea arabica*, Caura, 1933.

Marasmius palmivorus Sharples.
Or a closely allied species, H.R.B.J., coconut palms, 1936.

Marasmius spp.
Species of this genus which very rarely produce fructifications cause threadblights of many plants including *Coffea arabica*, *Coffea robusta*, *Sterculia caribaea*, *Dipteryx odorata*, cacao and citrus.

Naucoria semiorbicularis (Bull.) Fr.
A.K.B., St. Augustine, 1933.

Coprinus atramentarius (Bull.) Fr.
Saprophytic on dead leaves, Caura, 1933.

PHALLACEAE.

Clathrus cancellatus Tourn.
On rotten tree stump. J.M.W., Arena Forest Reserve, 1935.

LYCOPERDACEAE.

Diplocystis wrighti B. and C.
On dead leaves, Caura, 1936.

FUNGI IMPERFECTI.

SPHAEROPSIDALES.

SPHAERIOIDACEAE.

Phoma destructiva (Plowr.) Jamieson.
Causing leaf-spots and a fruit rot of the tomato. A.K.B., 1932.

Phomopsis citri Fawcett.
Causing a fruit rot of citrus fruit. C.W.W., 1934. A closely allied or identical species is found as a fruit rot on tomatoes, avocadoes, mangoes and papaws.

Septoria spigeliae Henn.
On *Spigelia* sp. W.F.S., St. Augustine, 1934.

MELANCONIALES.

MELANCONIACEAE.

Pestalozzia leprogena Speg.
A common saprophyte of fruit trees, &c., C.W.W., 1933.

MONILIALES.

MONILIACEAE.

Acremonium sp.
Causing yellow leaf-spots on *Cucumis sativus*. A.K.B., 1932.

Aspergillus citrisporus von Höhn.
On pupa of *Brassolis sophorae*. C.W.W., St. Augustine, 1933.

Aspergillus glaucus group (near *A. scheelei*). St. Augustine, 1933.

Aspergillus glaucus group (near *A. sejunctus*). St. Augustine, 1933.

Cephalothecium roseum Corda.
Causing a rot of maize cobs in wet weather, St. Augustine, 1933.

Oospora citri-aurantii (Ferraris).
Causing a soft rot of citrus fruit in field and storage, 1934.

DEMATIACEAE.

Hormodendrum cladosporioides.
From banana material, C.W.W.; from citrus material, R.E.D.B., 1935.

Stachylidium theobromae Turc.
From banana material, C.W.W.

Clasterosporium maidicum Sacc. (group).
From banana material, C.W.W.; from citrus material, R.E.D.B., 1935.

Helminthosporium torulosum (Sydow) Ashby.
Causing a leaf-spot and fruit rot of the banana. C.W.W.

Helminthosporium sp.
On elephant grass (*Pennisetum purpureum*). Causing considerable damage in wet weather. H.R.B.J., St. Augustine, 1933.

Stemphylium cucurbitacearum Osner.
Causing leaf-spots on *Cucumis sativus*. A.K.B., 1932.

Alternaria brassicae (Berk.) Bolle.
Also on cauliflower leaves and heads in field; and causing a blackening of the heads in storage. C.W.W., St. Augustine 1934.

The following collection of *Cercospora* species was made by W. F. Steven in 1933 and 1934. Much of the material was submitted to Professor C. Chupp of Cornell Universiry for identification. Steven's list is given below in full, irrespective of whether or not the species have been recorded previously.

* **Cercospora aleuritidis** Miy.
On *Aleurites triloba*. W.F.S.

Cercospora apii Fres.
On *Apium graveolens*. W.F.S., C. Chupp.

Cercospora apocyni E. and K.
On *Haemadictya* sp. W.F.S.

* **Cercospora atricincta** H. and W.
On *Zinnia elegans*. W.F.S.

* **Cercospora batatae**
(Syn. *C. ipomoeae* Wint.). On *Ipomoea* (? *hederifolia*) and *I. batatis*. W.F.S., C. Chupp.

Cercospora beticola Sacc.
On *Beta vulgaris*. W.F.S.

* **Cercospora bidentis** Tharp.
On *Bidens pilosa*. W.F.S., C. Chupp.

* **Cercospora bixae** Allesch. and Noack.
On *Bixa orellana*. W.F.S.

* **Cercospora bloxami.**
(Syn. *C. brassicola* P. Henn). On *Brassica sinensis*. W.F.S., C. Chupp.

* **Cercospora borreriae** E. and E.
On *Borreria* sp. W.F.S.

* **Cercospora brachiata** E. and E.
On *Amaranthus* sp. W.F.S., C. Chupp.

Cercospora bradburyae Young.
On *Cassia grandis*. W.F.S., C. Chupp.

* **Cercospora cajani** P. Henn.
On *Cajanus indicus*. W.F.S.

Cercospora canavaliae Syd.
On *Canavalia ensiformis*. W. F. S., C. Chupp.

Cercospora canescens E. and M.
On *Phaseolus* spp. W.F.S., C. Chupp.

* **Cercospora capsici** H. and W.
On *Capsicum annuum*. W.F.S., C. Chupp.

* **Cercospora clitoriae.**
On *Clitoria ternatea* W.F.S., C. Chupp.

Cercospora coffeicola Berk. and Cooke.
On *Coffea arabica*. W.F.S., C. Chupp.

* **Cercospora crotalariae** Syd.
On *Crotalaria juncea*. W.F.S.

* **Cercospora crotonophila** Speg.
(Syn. *C. trinidadensis*, Sol. and Stev., *C. tiglii*, P. Henn. on *Croton lobatus*, and *C. ricini*, Speg. on *Ricinus communis*). W. F. S., C. Chupp.

Cercospora cruenta Sacc.
On *Vigna sinensis*. W.F.S., C. Chupp.

Cercospora demetriana Wint.
On *Crotalaria juncea*. W.F.S.

* **Cercospora dolichi** E. and E.
On *Dolichos lablab*. W.F.S.

* **Cercospora fusimaculans**
(Syn. *C. panici*). On *Panicum maximum*. W.F.S., C. Chupp.

* **Cercospora gliricidiae** Syd.
On *Gliricidia sepium*. W.F.S., C. Chupp.

* **Cercospora gossypina** Cooke.
On *Gossypium hirsutum*. W.F.S., C. Chupp.

Cercospora henningsii Allesch.
(Syn. *C. manihotis* P. Henn., and *C. cassavae* E. and E.). On *Manihot utilissima*. W.F.S., C. Chupp.

Cercospora hibisci Tr. and E.
On *Hibiscus esculentus*. W.F.S.

* **Cercospora hibiscina** E. and E.
On *Hibiscus esculentus*. W.F.S.

* **Cercospora jahnii** Syd.
On *Tabebuia pentaphylla*. W.F.S., C. Chupp.

Cercospora longissima (Aug.) Sacc.
(Syn. *C. lactucae* Stev.). On *Lactuca sativa*. W.F.S., C. Chupp.

* **Cercospora lythracearum** H. and W.
On *Lagerstroemia indica*. W.F.S., C. Chupp.

* **Cercospora malachrae** H. and W.
On *Malachra capitata*. W.F.S.

* **Cercospora melongenae** Welles.
On *Solanum melongena*. W.F.S., C. Chupp.

Cercospora nicotianae E. and E.
On *Nicotiana tabacum*. W.F.S., C. Chupp.

Cercospora nubilosa E. and E.
(Syn. *C. dioscoreae*). On *Dioscorea alata*. W.F.S.

* **Cercospora pantoleuca** Syd.
On *Clitoria ternatea*. W.F.S.

Cercospora personata B. and C.
On *Arachis hypogaea*. W.F.S., C. Chupp.

* **Cercospora ricinella** (Sacc. and Berl.) Speg.
(Syn. *C. albidomaculans* Wint.). On *Ricinus communis*. W.F.S., C. Chupp.

Cercospora rosaeicola Pass.
On *Rosa* sp. W.F.S., C. Chupp.

Cercospora senecionis
On *Senecio* sp. (? *S. aureus*). W.F.S.

Cercospora sesami Zimm.
On *Sesamum indicum*. W.F.S., C. Chupp.

* **Cercospora sorghi** E. and E.
On *Sorghum vulgare*. W.F.S., C. Chupp.

Cercospora stizolobii Syd.
On *Stizolobium atterrimum*. W.F.S., C. Chupp.

* **Cercospora tectoniae** Stev.
On *Tectona grandis*. W.F.S., C. Chupp.

* **Cercospora trichophila.**
(Syn. *C. solani-torvi* Frag. and Cif.). On *Solanum torvum*. W.F.S., C. Chupp.

* **Cercospora viridula** E. and E.
On *Ipomoea batatis*. W.F.S.

* **Cercospora wildemanii** Syd.
On *Dolichos lablab*. W.F.S., C. Chupp.

Cercospora spp.
On *Carthamus tinctorius*, *Cassia bacillaris*, *Centrosema pubescens*, *Cissus sicyoides*, *Colocasia* sp., *Hibicus sabdariffa*, *Petraea volubilis* and *Stachytarpheta jamaicensis*.

† **Rhagnhildia manihotis** Solh. and Stev.
On *Manihot utilissima*. W.F.S., 1934.

TUBERCULARIACEAE.

Fusarium lateritium *Nees.*, var. *fructigenum* (Fries).
Saprophytic on dead tissues of citrus trees, 1934.

Fusarium lycopersici,
Causing tomato wilt. A.K.B., 1932.

Fusarium moniliforme var. *subglutinans* Wollenw. & Reink.
From Banana material. C.W.W.

† (NOTE.—The genus *Rhagnhildia* is identical with *Cercospora* except that the conidia are catenulate.)

* Not previously in the Trinidad List.

Fusarium oxysporum Schlecht.
Causing internal red rot of citrus fruit. C.W.W., 1936. *Det.* Imp. Myc. Inst.

Fusarium sambucinum Fuckel.
From banana material. C.W.W.

Fusarium semitectum Berk. & Rav.
From banana material. C.W.W.

Fusarium succisae (Schroet.) Sacc.
From banana material. C.W.W.

Fusarium sp.
Causing bakanae disease of rice. A.K.B., 1932.

Papularia sphaerospherma.
From banana material, C.W.W.; from citrus material, R.E.D.B., 1935.

Spegazzinia ornata Sacc.
From surface of citrus fruit, 1936. *Det.* Imp. Myc. Inst.

MYCELIA STERILIA.

Sclerotium oryzae Catt.
Causing a wilt disease of rice. A.K.B., 1933.

A FURTHER PRELIMINARY LIST OF TRINIDAD FUNGI.

Corrections.

Page.	*Column.*	*Line.*	*Corrections.*
1	2	5	For (Bir.) *read* (Biv.).
1	2	10	*Delete* Cystopus.
2	1	3	For Clinton *read* Rostow.
4	1	27	For Acanthostigimella *read* Acanthostigmella.
4	2	41	For erythrinse *read* erythrinae.
4	2	58	For Botrysphaeria *read* Botryosphaeria.
5	1	46	*Delete* Xylaria.
5	1	56	For tritis *read* tristis.
5	2	15	For Corticillium *read* Verticillium.
6	2	9	For flavolanta *read* flavolanata.
7	1	26	*Delete* Phyllachora.
7	1	55	For Gyperaceae *read* Cyperaceae.
7	2	10	For Schoroeteria *read* Schroeteria.
7	2	42	For Ceratelium *read* Cerotelium.
7	2	52	*Delete* Cerotelium.
8	1	2	For Ceretolium *read* Cerotelium.
8	2	50	For N.A.Fl. *read* N.Am.Fl.
9	2	22	For North *read* South. Also *add* after line 23:—eupatorii—columbiani Mayor. On Eupatorium inulaefolium H.B.K. Distribution—Trinidad, Brazil, Bolivia, Colombia.
9	2	36	For Helconia *read* Heliconia.
9	2	60	*Insert* Colombia.
10	1	11	For lappulaca *read* lappulacea.
11	2	29	*Delete* Uromyces.
14	1	48	For Sensulato *read Sensu lato.*
14	2	2	For alutacens *read* alutaceus.
14	2	12	For A.Nm.Fl. *read* N.Am.Fl.
14	2	26	For leidermus *read* leiodermus.
22	1	4	After leaf *insert* spot.
22	1	18	For (Bir.) read (Biv.).
22	1	35	For Clinton *read* Rostow.
22	2	25	After Drost *insert* C. theobromicolum Delacroix.
22	2	42	For though *read* through.
22	2	50 ff.	Read as follows: Marasmius equicrinis Mull. / Marasmius sarmentosus Berk. — "Horse-hair blight". These Fungi are external only and do not penetrate living tissue.
22	2	59	For B. & Br. *read* (B. & Br.).
23	2	39	Before premature leaf fall *insert* the fungus may cause.
24	2	14	*Italicise* (small italics) *Nectria theobromae.*
24	2	17	*Italicise* (small italics) *Phyllostica* sp.
25	2	1	For sup. *read* spp.
25	2	38	After Salmonicolor *insert* on.
27	2	11	For stage *read* stages.
28	1	35 ff	Read as follows:— Brachysporium sp., Helminthosporium sp., Heterosporium sp., Macrosporium sp. — on glumes. Leptosphaeria sp., Septoria sp. — on leaves.
28	1	52	For Lasiacis *read* lasaicis.
29	1	37 ff	*Read* as follows: Puccinia pallescéns Arthur, II / Puccinia sorghi Schw., II — Brown powdery rust pustules on leaves. *P. sorghi* is the more common.
30	1	3	For sativas *read* sativus.

INDEX.

Page.	*Corrections.*
(i)	For Aleurodiscus strumoscus *read* Aleurodiscus strumosus.
	For Aschersonia basicytis *read* Aschersonia basicystis.
	For Calyculosphaeria tritis *read* Calyculosphaeria tristis.
(ii)	For Diploda *read* Diplodia.
	For Fusieladium *read* Fusicladium.
(iv)	For Physarum mellum *read* Physarum melleum.
	For Polyporus alutacens *read* Polyporus alutaceus.
	For Poronia oedepus *read* Poronia oedipus.
	For Pycnoporus sanguinens *read* Pycnoporus sanguineus.
(v)	For Sphaerostilbe longiaca *read* Sphaerostilbe longiasca.
(vii)	*Italicise* Pineapple.
	Italicise Sugar Cane.

TROPICAL FRUITS AND VEGETABLES. AN ACCOUNT OF THEIR STORAGE AND TRANSPORT.

By. C. W. Wardlaw.
Low Temperature Research Station.

(Continued from *Tropical Agriculture*, XIV, 10, 1937.)

Sapodilla.

The Sapodilla, dilly, sapota, naseberry or chico (*Acras sapota*), a tropical American indigene, yields a white latex from which chicle, used in the manufacture of chewing gum, is obtained, and also fruits two to four inches in diameter, with a russetted scurfy skin and very sweet, spicy, yellowish, granular pulp.

Popenoe (4) states that the sapodilla can be shipped successfully with little care in packing. Fruits picked full-grown but hard do not begin to ripen for several days, permitting of transport over short distances without the use of refrigeration. He further states that sapodillas have been shipped from the Florida Keys to New York in tomato crates, each crate containing 6 small baskets of fruit.

According to Cheema and Ghandi (2), the sapodilla as grown in India is tolerant of temperatures below 40°F. At temperatures between 40° and 50°F. green fruits may be kept for one month, after which they will ripen normally on removal from cold storage.

Sapodillas, exported from Java to Holland in a cold chamber maintained at approximately 3°C. (37.4°F.) are stated to have arrived in fairly good condition. On being removed from cold storage, however, the consignments did not respond well to ripening treatment, uneven ripening, hardness and shrivelling being objectionable features. Fruits brought to a uniform maturity by a smoking treatment prior to shipment are said to have given more satisfactory results. Latex coating was unsuccessful as a means of preservation (6).

In cold storage experiments with small quantities of fully grown but unripe Jamaica fruit, stored for 16 days at 45°F., Smith (5) has reported favourable results. On removal to higher temperatures (80° to 93°F.) the fruit ripened in the course of two or three days to a product of good flavour. Comparable experiments carried out in Trinidad at temperatures of 45° and 50°F. were attended with less favourable results; the fruits suffered from desiccation and failed to ripen normally.

In experiments with sapodillas grown in the Philippine Islands, Gonzalez (3) observed that full-grown green fruits, held at 32°F. and then removed to room temperature (approx. 85°F.), ripened normally provided they were not kept at the lower temperature for more than five days. Eating-ripe fruit, which would normally keep at room temperature for three to four days only, may be held at 32°F. for two weeks in excellent condition.

Full-grown but unripe fruits may be treated with CO_2 gas for approximately 40 hours as a means of removing the astringency, the fruits becoming palatable 48 hours after the treatment. More prolonged CO_2 treatments exercised an inhibiting effect on ripening processes.

Campo (1) has recently described in some detail further storage trials with sapodillas grown in the Philippine Islands. The following Table indicates the average storage life of fruits of different maturities, green, turning and ripe, at different temperatures.

Influence of Temperature on Keeping Quality of Sapodillas (after Campo).

Average Storage Life.

Temperature.	Green Fruit.	Turning Fruit.	Ripe Fruit.
	days.	days.	days.
32°F. ...	5.6	6.4	12.6
50°F. ...	8.4	11.0	8.4
59°F. ...	18.0	16.4	5.8
68°F. ...	12.0	10.4	4.2
81.5°F. ...	6.6	5.4	2.0

For both green and turning fruit the best results were obtained at 59°F. a storage life of 18 and 16 days respectively being recorded; ripe fruits could be held in good condition at 32°F. for 12 days. Green and turning fruits, stored at 32°F. for not more than five and six days respectively, ripened normally when moved to room temperature (80° to 86°F.). At 50°F. green and turning fruits had to be transferred to room temperature within eight and ten days respectively in order to permit of normal ripening; eating quality was spoilt by more prolonged exposures.

References.

1. Campo, J. H.: Studies on the Storage Temperature Requirements of the Chico, Achras Zapota Linn. *Philippine Agric.* XXIII, 1934-35.
2. Cheema, G. S. & Ghandi, S. R.: Refrigeration as a Means of Preserving Mangoes and Other Tropical Fruits. *Agric. Jour. India*, XXI, 5, 1925.
3. Gonzalez, L. G.: A Study of the Respiration of the Chico, Achras Zapota Linn. *Philippine Agric.*, XX, 1931-32.
4. Popenoe, W.: Manual of Tropical and Sub-Tropical Fruits. *The Macmillan Co., New York*, 1920.
5. Smith, F. E. V.: Notes on Experimental Shipments. *West Indies Fruit and Vegetable Bul.* I. 2, 1936. (*For Official Use Only.*)
6. Transport and Maturation of Tropical Fruits. *Rev. Scient. Illustr.* June 8, 1929; *Abstr. in Int. Bul. Inf. Refrig.*, X, p. 738, 1929.

Soursop, Sweetsop and Custard Apple.

The soursop or guanabana (*Annona muricata*) and the sweetsop or sugar apple (*A. squamosa*) are of tropical American origin, the fruits being esteemed for the agreeable flavour of the juicy pulp. In cold storage experiments in Jamaica and trial shipments to Covent Garden, Smith (2) found that the fruits of this genus cannot withstand low temperatures at any stage of maturity.

The very soft texture of the ripe fruit of the custard apple or bullock's heart (*Annona reticulata*) has precluded its shipment from the tropics. When green the fruit is firm and possesses a turpentine flavour. If harvested at this stage, shipment overseas should not be impossible. Harvey (1) has indicated that green fruit, if treated with ethylene for two or three days, develops the full aromatic flavour characteristic of normal ripening in the tropics.

References.

1. Harvey, R. B.: Artificial Ripening of Fruits and Vegetables. *Univ. Minnesota Agr. Exp. Sta. Bul.* 247, 1928.
2. Smith, F. E. V.: Notes on Experimental Shipments. *West Indies Fruit and Vegetable Bul.* Vol. 1, No. 2, June, 1936. (*For Official Use Only.*)

Spinach.

For marketing in the fresh condition plants of the common spinach (*Spinacia oleracea*) are cut at the tap-root or pulled from the soil and trimmed, bunched, washed thoroughly in cool fresh water and crated. All dead and yellow leaves, and leaves injured by insects or disease, should be removed. Harvesting should be accomplished before the appearance of the seed-stalks. The market preference is for small, young, tender plants with small stems and roots (5).

When intended for distant markets, United States produce is placed in paper-lined lettuce crates, packed with crushed ice, and transported in refrigerator cars (5). Ridley (3) states that care should be taken to secure adequate ventilation within the cars. If soft rots are allowed to develop during transport, the consignment may be ruined in the course of two to three days. Bunching (with its attendant bruising), and washing, tend to increase the amount of wastage; on the other hand, unwashed spinach is considerably more susceptible to yellowing and wilting than washed spinach. It is here that the advantage of icing crates uniformly is most apparent (3).

Optimal storage conditions for spinach for a period of seven to ten days are afforded by rapid cooling, and by maintaining consignments at a temperature of 32°F. and R.H. of 90 to 95 per cent. (4). Rasmusson (2) records satisfactory storage of spinach for upwards of two months at 32° to 33.5°F. and a R.H. of 70 to 80 per cent. In experiments in which spinach was subjected to different concentrations of CO_2 during the initial cooling period, Brooks *et al.* (1) record that common spinach was not injured in any way; New Zealand spinach, on the other hand, showed damage to the tips of the leaves at high CO_2 concentrations.

References.

1. Brooks, C., Bratley, C. O. & McColloch, L. P.: Transit and Storage Diseases of Fruits and Vegetables as Affected by Initial Carbon Dioxide Treatments. *U.S. Dept. Agr. Tech. Bul.* 519, 1936.
2. Rasmusson, L.: Preservation of Vegetables in Cold Storage. *Inst. Int. du Froid Rep. Fifth Int. Cong. of Refrig.*, Rome, 1928.
3. Ridley, W. W.: Handling Spinach for Long Distance Shipment. *U.S. Dept. Agr. Farmers' Bul.* 1189, 1921.
4. Rose, D. H., Wright, R. C. & Whiteman, T. M.: The Commercial Storage of Fruits, Vegetables and Florists' Stocks. *U. S. Agr. Dept. Circ.*, 278, 1933.
5. Scott, G. W.: Spinach Production in California. *Calif. Agr. Exten. Serv., Circ.* 92, 1935.

Star Apple.

Wilcox and Hunn (1) have reported on the storage of large purple, small purple and green varieties of star apple (*Chrysophyllum cainito*) at 32°F. and 45°F. for periods of 30 to 50 days. In the course of storage, various types of shrivelling developed. Maturation changes were more marked in fruits stored at 45°F. The conclusion was drawn that star apples intended for cold storage should be picked in a half-ripe condition, cured in a well-ventilated room for two days and held at 32°F. for not longer than three weeks. From the data submitted by these authors the comment may be offered that fruits held at the lower temperature were subject to superficial chill effects; the flavour, however, was apparently not noticeably impaired.

Reference.

1. Wilcox, E. V. & Hunn, C. J.: Cold Storage of Tropical Fruits. *Hawaii Agr. Exp. Sta. Press Bul.* 47, 1914.

Sugar-Cane.

The cold storage of sugar-cane (*Saccharum officinarum*) planting material or "seed", as a regular plantation procedure is not practicable. Occasionally, however, it may be desirable to hold or transport this commodity in cold storage. According to Sartoris (1) the best storage temperature is 8° to 10°C. (46.4° to 50°F.), the cane being packed in some material which will preserve its moisture content. After storage at 6°C. (42.8°F.) bud and root development will still take place; storage at lower temperatures is inadvisable. During storage at 3°C. (37.4°F.), although the appearance of the cane remains unaltered, the physiological injury sustained is such that subsequent growth is precluded. Brief exposures at low temperatures, *e.g.*, 80 minutes at −2°C., also inhibit subsequent germination.

Reference.

1. Sartoris, G. . : Low Temperature Injury of Stored Sugar-Cane. *Jour. Agr. Res.* XXXVIII, 4, 1929.

Sweet Potatoes.

The sweet potato (*Ipomoea batatas*), one of the most valuable food crops in tropical and sub-tropical regions, is regarded in the United States as second only in importance to the Irish potato (10). As sweet potato roots are very sensitive to frosts, their storage assumes a special importance in those countries where the plant—normally a perennial under tropical conditions—must be cultivated as an annual. The storage of this crop is considered to be a sound economic practice in that it stabilizes the industry and makes an important food stuff available over the greater part of the year (22).

During storage, various types of rotting, originating as wound-infections, may assume serious proportions: special care must therefore be exercised in handling this commodity; a comprehensive account of field and storage diseases has been given by Harter and Weimer (10). In spite of improvements in storage-house construction and operation, annual losses in the United States may vary from 5 to 40 per cent. of the crop stored (10). In so far as several important field diseases may be carried over into storage and cause further damage, careful seed selection and disinfection, the maintenance of clean seed beds, and crop rotation, should be given due consideration. Most of the commercial crop is derived from a comparatively small number of varieties (Big-Stem Jersey, Yellow Jersey, Porto Rico, Nancy Hall, Southern Queen, &c.), dry and moist-flesh types being chosen according to local preferences; as grown under Mississippi conditions, Price (19) considers that Triumph and Porto Rico, judged by yield and keeping quality, are the two best varieties.

An extensive literature is now available on the storage of sweet potatoes. Major requirements for successful storage include sanitary storage houses, avoidance of low temperature injury prior to harvesting and during storage, careful handling, exclusion of diseased roots, thorough curing after harvesting, and observation of correct conditions of temperature and humidity.

Changes during Growth, Curing and Storage.

During growth the sugar content is low (11); there is a gradual decrease in the percentage of moisture, a gradual increase in the percentage of starch and sucrose, but no increase in the percentage of reducing sugars (7). The removal of the tops or vines about six weeks before harvesting induces an increase in the percentage of moisture and a corresponding decrease in the percentage of carbohydrates in the tuberous roots. Uncured sweet potatoes contain a higher percentage of moisture and a lower percentage of starch and sucrose than do corresponding samples which have been cured. Frosting of tops causes an increase in the percentage of moisture and sucrose and a decrease in the percentage of total starch and total carbohydrates (8).

Immediately after harvesting there is a rapid transformation of starch into sucrose and reducing sugars; according to Hasselbring and Hawkins (11) the initial transformation is mainly due to internal causes and is only slightly affected by external conditions. These initial changes appear to be associated with the cessation of the flow of materials from the vines. In sweet potatoes stored at 53° to 62°F. the moisture content remains fairly constant. Variation in temperature during storage is reflected in the relative proportions of starch and sucrose present in the roots. At a storage temperature of 39°F. there is a rapid disappearance of starch and proportionate increase in sucrose.

Johnstone (12) has shown that considerable differences exist between different varieties. Thus in a comparison of the Porto Rico and Triumph varieties, the former was found to have a higher respiration rate, greater enzymatic activity and a higher moisture content.

Pre-Storage Factors.

Schuster and Phillips (20) have described experiments in which sweet potatoes, grown under different fertiliser treatments, were held in cold storage at 55° to 65°F., after curing at 80° to 85°F. Some evidence was obtained that plots treated with potassium sulphate yielded the most marketable potatoes.

As the sweet potato is very sensitive to low temperatures, avoidance of cold injury before harvesting is important (18, 22). In countries where earth temperatures may fall to the chilling temperature for sweet potatoes, late harvesting should be avoided. As soon as the growth of the vines is arrested by the onset of autumnal conditions, a marked increase in the water-content of the roots takes place; in conjunction with low soil temperature this physiological condition is inimical to good storage later. An indication of the adverse effects of delayed digging is afforded by the following illustrations: Triumph sweet potatoes dug before frost and five days after frost showed losses of 0.4 and 75 per cent. respectively after four to five months in storage; the Porto Rico variety, in a parallel experiment, showed 0.8 and 71 per cent. wastage respectively. While losses resulting from delayed harvesting are not always so striking, these data indicate the risk that may be involved.

As far as is practically possible, all diseased or injured roots should be culled out from sound ones prior to storage.

Harvesting Operations.

Every sweet potato root is wounded on being detached from the parent plant. It is through these and other wounds that pathogenic micro-organisms gain entrance to the tissues. Moreover, the skin which covers the root is delicate and easily broken. During all digging and handling operations, therefore, great care should be exercised to keep wounding and bruising at a minimum. Before being taken to the storage house, potatoes

may be allowed to remain for an hour or two in the sun; this allows the dirt to dry and the skin to harden (10); where possible, bright windy days should be chosen for digging operations; Beattie (2) recommends that padded baskets and spring waggons should be used for handling this commodity from field to storage.

Methods of Storage.

Although most of the important varieties of sweet potato can be stored successfully, some are consistently less subject to shrinkage and decay than others. Several methods are employed, including storage in (i) earth banks, clamps or pits, (ii) cellars, and (iii) specially constructed houses. In colder regions pits must be specially protected against freezing and cellars against inadequate ventilation, which is known to be conducive to rotting. The modern storage house, with controlled temperature and humidity, has proved the most uniformly successful (10,13, 14, 22).

Brash (3) has described some non-refrigerated storage trials, using Trinidad-grown sweet potatoes, in which the roots were held in pits or clamps, ventilated pits, sand-pits, bag and heap storage in store rooms, and shelf storage in an open, wire-net corn-crib. These tests showed that storage for two months was possible and that a total loss in weight of about 15 per cent. might be expected; pit storage gave the best results.

Directions for the construction of suitable houses have been given by Thompson *et al.* (22), Crider and Albert (5) and Dawson (6).

Storage House Management.

Preparations for handling the crop are carried out along the following lines (10, 22). Before the roots are brought in, the storage house should be thoroughly cleaned and disinfected or white-washed. Disinfection may be done by spraying once or twice with a solution of copper sulphate to which a little lime has been added or lime sulphur or Bordeaux mixture may be used. Still better results may be obtained by fumigating with formaldehyde gas liberated by the addition of potassium permanganate to formaline. (The proportion should consist of three pints of commercial formaline and 23 ounces of potassium permanganate for each 1,000 cubic feet of space. The permanganate should be placed in deep receptacles, the formaldehyde poured on it, and the house closed tightly for 24 hours. The irritant effects of formaldehyde gas on eyes and lungs should be borne in mind in conducting this operation. If the house is large, several receptacles, suitably distributed, should be employed.) The house should be thoroughly dried, by a slow fire if necessary, before the potatoes are taken into storage; while the potatoes are being stowed, it is also desirable to drive off all excess moisture.

Stowage.

For the actual disposal or stowage of roots in the storage house, crates or bins may be used. When crates are used, slatted floor-boards should be installed to allow of air circulation under the crates. The latter may be stacked in rows to a height of eight feet. In bin stowage, the bins should be filled layer by layer throughout the storage house; for various reasons this is preferable to a system in which each bin is completely filled at a time. Some sub-division of large bins is also desirable.

Curing.

Before entering on a prolonged period in cold storage, it is important that all superficial wounds should be adequately protected from fungal infection by the development of wound cork. A preliminary curing period, to provide the optimum conditions for cork formation, is therefore essential to successful storage. It has been ascertained that cork formation proceeds most rapidly at a temperature of 89°F. and R.H. of 92 per cent.; under these conditions, cork begins to form in two days; this is well advanced by the fifth or sixth day. The storage technique now widely adopted, conforms to this knowledge. At lower and higher temperatures, and at a lower humidity, cork formation takes place less rapidly. Some investigators consider that a curing temperature of 85°F. is too high, as it causes excessive shrinkage, and advocate a temperature of 75°F. It has been seen, however, that healing is slightly slower at 75°F. Although shrinkage during curing at 75°F. is slightly less than at 85°F., it has been found that the subsequent shrinkage during prolonged storage, at 55°F., is greater in roots cured at the lower temperature.

When the potatoes have been placed in the storage house a temperature of 80° to 85°F. should be maintained for ten to 14 days; thereafter it should be gradually lowered to 55°F.—the optimum storage temperature for this commodity. The high temperature maintained during the curing period helps to drive off surface moisture. Thereafter temperature and humidity should be carefully watched. If moisture tends to accumulate, ventilators should be opened to effect the necessary discharge; alternatively, the temperature may be raised for a day or two (10, 22).

Moisture Losses during Curing.

According to Kelley (13, 14) and others (22) the moisture loss from sweet potatoes cured on a commercial scale at 80° to 85°F. is less than from potatoes cured at a lower temperature. Although roots may lose from eight to ten per cent. of their fresh weight during the curing period at 85°F., they do not appear shrunken or shrivelled (22). The rate of water loss is rapid at first, but after two weeks, when cork formation has been completed, transpiration proceeds, under constant conditions, at a slow steady rate.

The flesh of properly cured sweet potatoes when cooked is apparently no less moist than that of uncured ones; because of various metabolic changes the flesh may even appear more juicy. According to Thompson *et al.* (22) curing effects a marked improvement in the sweetness and general culinary quality of sweet potatoes; this is accounted for by the rapid change of much of the starch to dextrin and sugars.

Care in Storage.

Sweet potatoes in storage should not be handled, unless for immediate marketing. It is considered unsafe to pick them over to remove decayed roots, as sound ones may be wounded and infected in the process (10). Wounding caused by handling and by mice and rats, with subsequent infection by such organisms as *Rhizopus nigricans*, is responsible for most of the decay in storage.

Storage Temperature and Humidity.

The conditions generally accepted as providing optimal storage for sweet potatoes are a temperature of 50° to 55°F. and a relative humidity of 80 to 85 to 90 per cent. (4, 10, 22). This ensures sound storage for four to six months.

Lauritzen (16) claims that black-rot disease of potatoes in storage, caused by *Ceratostomella fimbriatum*, can be almost completely controlled by maintaining a temperature of 43° to 50°F. and R.H. of 90 per cent.; to avoid chilling the higher temperature would be preferable. The same author (15) has also published comprehensive observations on the temperature factor as it affects the activities of various rot-producing fungi during sweet potato storage: by proper curing (ten days at 72° to 90°F. with a R.H. of 90 per cent.) followed by storage at 50° to 59°F., with a R.H. above 80 per cent., the protective mechanism operative against the inroads of pathogens is most effectively developed and maintained. The data submitted indicate the importance of providing conditions favourable to rapid wound healing.

Harter and Weimer (10) recommend that during transportation and even on the market, sweet potatoes should also be held at 50° to 55°F. and kept as dry as possible. For sweet potatoes of the white variety grown in Virginia, Kelley (13) recommends a temperature of 38° to 40°F.

In an early record, 1902, Taylor (21) indicated that sweet potatoes could be safely shipped over long distances; freshly dug potatoes, wrapped and unwrapped, were successfully transported from Virginia and New Jersey to London; the unwrapped tubers carried better than the wrapped.

In shipments of sweet potatoes grown in Montserrat, B.W.I., it has been found that a temperature of 45° to 50°F. is unsuitable. The evidence available suggests that storage temperatures lower than 60°F. are harmful to this crop (23).

Physiological Diseases in Storage.

Internal Breakdown.—A type of internal breakdown of sweet potatoes, believed to be associated with high storage temperature and low relative humidity, is characterised by the absence of external symptoms and by the formation of cavities in the potato tissue, the first cavity being at the centre; the affected tissue has a cottony appearance (1). In extreme cases, internal breakdown can be detected by the sponginess of the potato when squeezed (9, 10). In the United States, this physiological disease is quite prevalent. The extent of breakdown increases with the time in storage.

Chilling Injury.—Lauritzen (17) has established the fact that sweet potatoes are subject to chilling when exposed to temperatures below 48°F., an important effect of such physiological injury being to increase the susceptibility of the roots to various rotting organisms. Chilling injury was not observed in potatoes stored at 49°F. or 50°F. Slight injury, indicated by the appearance of internal discolouration, was observed after an exposure of ten days at 32.2°F. and after 29 days at 40°F. The extent of chilling increases with the duration of exposure to the low temperature. In roots chilled at 32.2°F. for 29 days the injury sustained was such as to preclude germination.

According to Thompson *et al.* (22) when sweet potatoes were subjected to 40°F. for three weeks or more, 40 to 90 per cent. of the roots rotted; some rotting also resulted from exposure for only two weeks at 40°F.: roots chilled for two to five weeks at 40°F. and then stored at 55°F. failed to produce sprouts when bedded.

Storage Diseases.

Several micro-organisms are responsible for the production of diseases both in the field and during subsequent storage; others are only actively pathogenic in storage. In attempting to control wastage in storage attention must be given to: (i) the possibility of eliminating infectious micro-organisms or infected material; (ii) avoidance of injury during digging and handling operations; (iii) providing suitable storage conditions; (iv) the use of fumigation or other disinfectant treatments. Although recommended by certain investigators, the practice of fumigating sweet potatoes in storage by burning sulphur, or releasing formaldehyde vapour from formaline, as a means of killing fungal pathogens, is inadvisable. The experiments of Harter and Weimer (10) showed conclusively that the fungi were not killed but that the potatoes were severely injured and decayed more rapidly than comparable untreated lots.

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Tomato.

The tomato (*Lycopersicum esculentum*), a plant native to tropical America, is now commonly grown in all warm countries and in temperate regions under glass. Commercial fruit can be grown with considerable success in the tropics, particularly in dry districts or during the dry season. Imported seeds of good varieties should be used wherever possible ; seeds from selected fruits grown locally may also yield satisfactory crops (30).

General Considerations.

For marketing as a salad fruit, tomatoes should possess good shape, colour and flavour and should be free from mechanical injuries, blemishes and decay ; they must also be quite ripe but not soft or flabby (43).

The commercial tomato is represented by a large number of varieties which have been produced by hybridisation. In size, shape, colour and constitution of fruits, a wide range in variation is to be encountered among named types. In respect of the several characters enumerated, marked preferences are to be found in the markets of different countries. No considerable difference in response to storage temperature in different varieties grown in the same area is clearly evident in the literature examined.

As the demand for tomatoes is continuous throughout the year, the long distance transport of what is admittedly one of the more delicate vegetable commodities is a common practice. Accordingly the crop is usually reaped somewhat immature to allow for transport and marketing as required in particular circumstances ; these differ greatly in different parts of the world. The conditions under which the crop is grown and harvested are also many and varied. As a rule allowance is made for some ripening during transport ; this is completed during the marketing period.

In all considerations of tomato storage the disease aspect requires careful attention, the number of general and specific pathogens to which fruits are susceptible during development and ripening being very considerable. On this subject an extensive literature is now available (43). In addition, various physiological maladies, originating either in the field or during storage, may sometimes assume serious proportions. Field diseases of the growing plant are also numerous; vines which have been attacked not only yield less fruit but indirectly the quality of the fruit may also be affected (43).

A feature of tomato growing in some regions is that the entire production must be harvested and sold within a few weeks (51) ; in these circumstances the market price tends to suffer from glut conditions. Refrigerated storage may accordingly be used to advantage in regularizing sales and in prolonging the marketing period.

Chemical Changes during Development and Ripening.

A comprehensive review of the numerous chemical investigations published prior to 1920 on tomato composition has been given by Sando (50).

During development there is a gradual increase in acidity, followed by a decrease as ripening takes place.

During the ripening of tomatoes on the plant from the full-grown green stage onwards, there is, according to Rosa (46, 47), a decrease in total solids, starch, acidity and acid-hydrolysable carbohydrates, and an increase in soluble solids and sugars. "The increase of soluble solids is partly absolute, partly relative, in vine-ripened fruit; in artificially ripened fruit the increase is mostly relative, due to loss of insoluble solids (starch) and a slight increase of sugars" (47). Sando (50) and Bigelow (5) indicate that the acidity continues to increase during vine-ripening. Final maturation is, however, accompanied by a definite decrease in acidity.

Various opinions have been offered as to the identity of the acid or acids present in the tomato; the preponderance of opinion now favours the view that citric is the principal acid present. Little or no cane sugar is present in the tomato, invert sugar being responsible for the sweetness of the ripe fruit.

A correlation is believed by some workers to exist between rainfall conditions and the degree of acidity observed in fruits, high rainfall favouring the production of acid. Sando states, "In this connection it may be worth while to suggest that a tomato with excessive water content may have the intercellular spaces sufficiently diminished so that gas exchange is impeded. Under such conditions a deficiency of oxygen might result in an accumulation of acid, due to incomplete oxidation of carbohydrates to carbon dioxide" (50).

Analyses show that in respect of those substances on which flavour and palatability depend, fruit picked green and allowed to ripen is definitely inferior to vine-ripened fruit. "When green fruit is commercially ripened, however, changes take place, which, although corresponding in general trend to those of normal vine-ripening, nevertheless fail to bring the fruit to the same degree of ripeness attained normally. The artificially ripened tomato is lower in total sugar than vine-ripened and higher in acid. The ratio of sugar to acid in the former is 5.54, while in the latter it is 6.34. In other words, the artificially ripened fruit is different in taste, due to the lack of one constituent and an excess of the other" (50). Fruits picked turning, *i.e.*, showing evidence of ripening colour, compare more favourably with vine-ripened mature fruit than fruit picked full-grown green, *i.e.*, the turning period is critical in the production of sugar and decrease of acids.

During the ripening of full-grown green tomatoes in storage, the starch content diminishes rapidly; the increase in sugar content, however, is small when considered as a percentage of the fresh weight (47). Pigment changes giving ripening colour take place much more slowly than the starch hydrolysis. The maximum sugar content is reached about four days after picking when fruits harvested full-grown green are held at a temperature of 25°C. (77°F.); at this stage fruits have become partly coloured. Thereafter the sugar content decreases so that in fully coloured fruits the sugar content may be even less than it was in the green fruit at harvesting. At 19°C. (66°F.) and lower temperatures, the sugar content continues on the up-grade for a longer time.

At low temperatures acids are lost more rapidly than sugars, flavour and quality being affected if storage is prolonged (54).

According to Sando (50), analyses of tomatoes, commercially picked and ripened with and without ventilation, show striking differences. In the absence of ventilation, the acid content is high and the sugar content low, indicating incomplete oxidation of the carbohydrates to carbon dioxide, with consequent accumulation of acid. Non-ventilated fruit accordingly suffers in respect of flavour, which tends to be insipid. To a lesser extent Sando considers that wrapping fruits may produce similar undesirable effects. Lack of ventilation also retards ripening and delays the appearance of ripening colour and the development of softness. Sando concludes that lack of ventilation is probably the main cause of inferiority in taste and keeping quality in tomatoes.

House *et al.* (20) have ascertained that ripe tomatoes are richer in vitamins A and C than are green fruits. The commercial method of ripening tomatoes by the use of ethylene gas produces fruit which is as rich in vitamins A, B and C, as fruit which has been picked green and ripened in air. Vine-ripened fruits are superior in vitamin C content to either green or artificially ripened fruits (*See* Ethylene Ripening).

Pre-Storage Factors and Quality.

Various pre-storage factors may play a part in determining the subsequent eating and keeping quality of fruit taken into storage.

Colour Development.—On the question of colour development, MacGillivray (28) and others (13, 18, 47) have called attention to the effect of high constant temperatures on the production of yellow pigment (carotin) and the suppression of the red pigment (lycopin) in tomatoes. High temperatures during part of the day do not entirely suppress the formation of the red pigment; temperatures of above 30°C. (86°F.), operating on the full-grown, whitish-green fruits of normal red varieties, give rise to the predominant yellow colour of carotin. A temperature of 73° to 77°F., on the other hand, favours the development of lycopin. The importance of the temperature factor as affecting developing and ripening fruit is modified by the amount of foliage present and the shade which it affords the fruits; foliage development, in turn, is determined by the growth conditions provided, disease incidence and other

factors. It has been ascertained that the flesh of fruits well protected by leaves may be anywhere from 13° to 25°F. lower than fruits fully exposed to the sun. In general, fruits on plants of poor foliage will undergo development at a higher average temperature than fruits on plants of good foliage. Rosa (47) has pointed out that temperatures in the field not only affect the final colour but also the rate of ripening: by inference fruits taken from plants of poor foliage may be expected to ripen more rapidly than fruits from plants of good foliage.

Effect of Fertilisers.—In a study of the effect of fertilisers on handling quality and chemical composition, Cochran and Webster (10) found that any precise correlation between field treatment and subsequent storage quality was difficult to obtain; this has also been the experience of other workers (59, 61). Some evidence has been obtained that fruits with a low content of pectic materials store best (10).

The Effect of Soil Moisture.—Brooks and MacGillivray (7) have shown that the percentage dry matter in tomatoes varies inversely with the percentage of soil moisture: the largest quantity, the largest number, and largest sized fruits were produced in a soil whose moisture content was estimated at 70 per cent.

Temperature of Growth.—Rosa (47) has observed that full-grown green fruits, which have come to maturity in the course of several weeks of cool weather, but without frost, ripen more slowly at 77°F. than do fruits grown under warmer weather conditions.

Late Harvesting.—According to Wright *et al.* (64) tomatoes left on the plants at the end of the growing season are inclined to be watery and of poor quality.

Disease Incidence.—Since a not inconsiderable number of field diseases or latent infections may be carried over into storage and develop with destructive effects during transport and ripening, a knowledge of field diseases is of great importance.

Physiological maladies (during growth) may on occasion also be destructive; the following may be briefly mentioned: puffiness (27, 43, 60, 62) is believed to be due to abnormal conditions of nutrition (excess of nitrogen, deficiency of phosphorus, &c.); blossom-end rot is ascribed to environmental conditions, including irregularities in water supply, drought, &c. (43); mis-shapen fruits are due to irregularities in growth, this being chiefly varietal; cracks are due to irregular conditions of growth and water supply; various other blemishes also occur whose precise cause has not been diagnosed. Any of these maladies may cause depreciation in the value of consignments intended for export; as far as possible affected fruits should be set aside during grading operations.

Sun-scald, due to excessive exposure to bright sunlight, affects immature green fruits to a much more marked extent than full-grown and colouring fruits. It is chiefly found in the exposed fruits of plants whose foliage has been quickly destroyed by pathogenic agencies. Sun-scald is indicated by the presence of necrosis, and discoloration to a bleached appearance, of tissues on the exposed side of the fruit. Lesions caused by sun-scald are not always noticeable at the time of harvesting; they develop during transport and marketing and are important as a means of ingress of pathogenic fungi and bacteria (43).

A disorder of greenhouse tomatoes, known as blotchy ripening, is considered by Seaton (52) and Seaton and Gray (53) to be "due to conditions which result from the withdrawal of water from the fruits during periods of excessive transpiration, occurring two to five days before the fruit ripens." This physiological disease is of importance during the early cropping period but is usually absent in late season fruit; it rarely occurs under field conditions. The disease is characterised by the failure of the outer wall of the fruit to develop and colour normally. The individual blotch may be relatively large, involving 25 to 50 per cent. of the fruit surface, or it may be small and inconspicuous. As the fruit approaches maturity the blotched areas remain hard and green and later assume a waxy or glassy appearance. The vascular strands lying below the blotches invariably have a brown necrotic appearance. In severe cases cavities may develop in proximity. Histological studies indicate that it is the breaking down of the large parenchymatous cells—with concomitant hindrance of translocation to the outer tissues—that is largely responsible for the development of the blotched appearance. The disorder is almost entirely restricted to mature fruits.

All fruit suspected of being abnormal in any respect should not be packed for overseas transport.

Harvesting Maturity.

According to market requirements and the duration of the transport period, tomatoes may be harvested over a wide range of maturity, from full-grown green, to completely coloured fruit (48). According to Krone (24), tomatoes should always show some colouring at harvesting, *i.e.*, a definite tinge of pink at the distal or stylar end. His view that they should never be picked when totally green cannot be accepted in its entirety: consignments to be transported overland in the United States, and shipments of West Indian fruit to the Canadian market, for example, are largely based on fruit harvested full-grown, but still green (18, 33, 60, 64).

The criteria for deciding when the "full-grown green" or "mature green" stage has been reached are largely a matter of experience, but small differences in colour and general appearance enable the observant picker to make a very well standardised selection of fruit of the desired maturity (33). The harvesting of immature green fruit should be avoided. Where partly coloured fruit is being harvested the quantity

of over-ripe fruit may be kept at a minimum by harvesting at frequent intervals. The following maturities are recognised: full-grown green; just colouring, *i.e.*, with first trace of ripening colour only; medium ripe, *i.e.*, one-third coloured; ripe, *i.e.*, two-thirds or more coloured.

Various investigators are agreed that tomatoes ripened on the vine are superior in flavour to those picked green and ripened in storage; hence the superiority of locally grown hot-house fruit, which is usually picked when almost fully coloured, to that picked green and transported long distances.

Sando (50), reporting on conditions in 1920 has stated that Florida fruit intended for shipment throughout the United States was picked when grass-green, and that complaints were sometimes received because of the immaturity of consignments. Immature fruit ripens very slowly and abnormally and tends to shrivel quickly; the flavour is also poor. A further disadvantage of the arrival of green fruit at the terminal point is that it may promote glut conditions while awaiting ripening; coloured fruit, on the other hand, can be disposed of immediately. At the other extreme of picking maturity, Rosenbaum (49) has shown that the development of tomato diseases during transport is favoured by packing over-ripe fruit, a statement amply confirmed by subsequent investigators.

For tomatoes grown in the West Indies and intended for export, Wardlaw and McGuire (60) have recommended that fruits should be harvested full-grown green, *i.e.*, the last stage of greenness prior to the development of orange or pink ripening colour; this allows of moderately prolonged storage. Under circumstances of rapid delivery and distribution, on the other hand, fruit showing colour may also be picked for export; it has been seen that from the point of view of quality, colouring fruit is to be preferred.

(*To be continued.*)

REVIEWS.

THE BIOLOGICAL CONTROL OF INSECTS.

(*With a Chapter on Weed Control.*)

By Harvey L. Sweetman. *Comstock Publishing Co.*, Ithaca, N.Y. 1936, pp. xii+461, 142 figs. Price $3.75.

This is the first book to appear on the biological control of insect pests. It is therefore welcomed as an important and long-awaited addition to the literature of economic entomology, and it can be recommended as a comprehensive, authoritative and well balanced survey of what is perhaps the most interesting and, when successful, certainly the best method of fighting insect enemies. The author has not evaded the obligation to assess the results of work in this field, nor to estimate the possibilities for the future. His judgments are made without dogmatism, and in the opinion of the reviewer they are exceptionally sound.

After a short chapter on the theoretical basis of biological control, and one on the use of resistant plants, the author reviews in considerable detail the diseases of insects caused by viruses, bacteria, fungi and protozoans, and their parasites and predators among the nematodes, insects, spiders and other arachnids, and vertebrates. The value of each group is discussed, both naturally and as employed by man. Then follow some general considerations on the relations between pests and their insect enemies, and descriptions of the technique of introducing and establishing these in new countries. The achievements in biological control are assessed by the presentation of lists of pests that have been subdued, in greater or less degree. The last chapter is an excellent account of the biological (strictly, entomological) control of noxious weeds.

In adverse criticism the reviewer would mention only omissions and these are largely matters of limitation of space and personal preference. The practical value of the book might have been increased by additional information on the practical details of actual introductions that have been made. The numbers of individuals liberated, the number and range of liberations, the intervals that occurred between liberation, recovery and control, methods of estimating control, and similar topics are allotted less space than might be desired. Readers in the West Indies will be disappointed to find scarcely any reference to the interesting work of Myers and Box, and of Tucker.

The achievements and possibilities of biological control having been surveyed so extensively, the opportunity of summarizing the principal results may be taken here. Reviewing first the organisms involved in control, we find that epidemics of virus, bacterial and fungous diseases of insects occur frequently and greatly reduce the losses caused by many pests. The artificial dissemination of these diseases, however, has met with little or no success, except in a few recent experiments. The method is worth intensive study, because there are already indications that spraying or dusting with bacterial and fungous spores may become a better method of controlling certain pests than spraying with oil or with compounds of arsenic. Of invertebrate animals, only the insects have as yet been employed by man, though a limited use may yet be found for parasitic nematodes, worms, predaceous mites and even some spiders. Among the insects, according to the author's carefully prepared lists, there are some 87 families that include parasites of other insects, and 167 including predators. Almost all of the parasites are members of the orders

Hymenoptera (bees, ants, wasps and related insects) and Diptera (flies), but predators occur in almost all the large orders. Of the 25 insects most successfully employed by man against insect pests (according to the author's lists), 15 are small Hymenopterous parasites representing eight families, two are higher wasps (Scoliidae), three parasitic flies (Tachinidae), four predaceous beetles (Coccinellidae), and one a small bug (Miridae), which sucks the eggs of a sugar-cane leafhopper. In weed control a considerable variety of insects has been used; the most successful have been the Pyralid moth, *Cactoblastis cactorum*, and the scale-insects of the genus *Dactylopius*, both introduced for control of Prickly Pears in Australia. Vertebrate predators destroy great numbers of insects, but with the exception of a few species, such as certain small fishes for control of mosquito larvae and the toad *Bufo marinus*, their introduction to new countries has more often been harmful than beneficial.

The success of biological control of insects, if still questioned, will be demonstrated by perusal of this book. The losses due to a large number of pests—some 26 in the author's list of well established successes—have been eliminated or greatly reduced, at a small fraction of the cost which other methods, if possible at all, would have involved. Comparatively little has thus far been attempted for control of weeds, but the magnitude of the most successful case—the liberation of vast areas from the strangle-hold of the Prickly Pear in Australia—in itself compensates for this. The future possibilities in the use of natural enemies of both insect pests and weeds are exceedingly great, and it is certain that successes will continue to be multiplied indefinitely.

The limitations of the method are just as clear. The most important of these at present is geographical, a majority of successes against insect pests having been attained in relatively small areas, especially islands or regions that are insular ecologically. No less than eight of the 26 successes regarded by the author as outstanding have occurred in the Hawaiian Islands, five in New Zealand, two in California, two in Fiji, and one each in Italy, Japan, Manitoba, British Columbia, Cuba, Puerto Rico and Mauritius. Only two of the 26 pests—the Cottony Cushion Scale and the Woolly Apple Aphis—have been controlled in many countries. None of the greatest achievements in biological control has concerned any of the world's worst insect pests, of importance comparable, for example, to that of mosquitoes, tse-tse flies, locusts, termites or to mention single species, of the House-fly, Mexican Boll-weevil, Pink Boll-worm or Mediterranean Fruit-fly. It is difficult to predict the chances of success against such pests. In some cases it may perhaps be obtained by the gradual building up of a strong "biotic resistance", by the successive introduction of many enemies. Thus far most successes have been won by the use of a single, highly specific, parasite or predator. In only a few cases, notably that of the Gipsy Moth in the eastern United States, have very numerous species of foreign insect enemies been tried against a single pest, and in this case considerable progress towards control appears to have been made.

A matter for encouragement is that few mistakes, followed by undesirable results, are to be recorded in the history of biological control, even in the case of plant-feeding insects for weed control. The worst errors have been the introduction of vertebrates, such as the mongoose and the Mynah Bird, but these occurred long ago and have not been repeated in modern practice. It has been suggested in some cases that a series of introduced parasites of a single pest may, by harmful interaction, be less effective than a smaller number or even than a single parasite. This view has never been proved and probably applies very rarely, if at all.

A. M. A.

* * *

COTTON PROGRESS IN BRAZIL.

By N. S. Pearse. *Int. Fed. of Master Cotton Spinners' & Manuf. Assoc.*, Manchester, 1937, 184 pp.

This is a report of a five weeks tour of the cotton tracts of Brazil by the General Secretary of the International Federation of Master Cotton Spinners' and Manufacturers' Associations. It is primarily technological in outlook, but contains a mass of useful information about the conditions under which Brazilian cotton is grown and prepared for the market.

There are impressive accounts of systems of seed control and fumigation and cotton classification by the cotton services of the State governments, but there is no critical discussion of their efficiency. Experience of official efforts to suppress malpractices in the Indian cotton trade prompts the enquiry "Does Government control and classification work"? The author gives no detailed information on this point, but from passing references throughout the book and his summary of the complaints of European spinners in his Conclusion, it appears that the Brazilian governments have had no more success than the Indian governments in safeguarding the reputation of their cotton. He suggests stricter control and more rigorous enforcement of the law. Elimination of malpractices by official control has never been found practicable in India, however, and it does not seem likely that it will be easier in Brazil. Most of the ginneries, especially in north Brazil, are very small and this increases the work of control and classification. Even with the best intentions it must be more difficult to make up an even running lot from the products of a lot of small ginneries than from one or two large ones. In the long run, however, the best method of improving the marketing of Brazilian—or any other—cotton will be to bring it home to the ginner that good cotton pays better than bad.

J. B. H.

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

Difficulties in Milling Machine-Loaded Cane.—*By F. Wiley, J. Mc Lean and A. F. C. Kuhlman.*

These writers report that while undoubtedly the adoption of the rake and grab-hook system of mechanically loading cane has been found a wonderful labour-saving device on some estates in Hawaii, it picks up at the same time trash, soil, mud and stones, and tramp iron, which leads to a series of quite serious difficulties in milling and in clarification by those using it.

Stoppages are frequent, and the rate of grinding is often slowed down as much as 40 per cent. Extraction suffers, owing partly to the high trash content*, but partly also because of the necessity of keeping the back rolls slacker than usual on account of the slippage caused by the mud in the cane. Clarification is made difficult, owing to the presence of mud in the juice, which causes a slower settling rate, and in some cases the volume of the settlings has increased from 20 to 75 per cent.

This in turn decreases the capacity of the filters, and sand and grit interfere with the normal operation to some extent. Where plate-and-frame presses are in use, the juice-line to the filters becomes clogged with sand. Due to the lower purities thus caused, the total factory losses of sucrose have increased at Waimanalo to date 3.5 per cent., or 363.8 tons of sugar over last year's figures. Another difficulty is that the firing of the boilers has become troublesome as the result of so much green matter being taken into the mill.

It is the rocks and tramp iron that form the greatest source of milling trouble, because of the mechanical damage done to the equipment. The steel slats of the cane carriers have been bent and broken, and the revolving knives have struck rocks and pieces of tramp iron, making it necessary to remove and replace blades. The crusher and the succeeding mills have shown increased wear from the sand and grit. And all this in spite of the fact that a good amount of the rocks and tramp iron are separated by a man stationed at the unloader for that purpose.

Any interruption in the flow of cane through the mill is of course detrimental to good extraction. Besides, the temporary shortage of bagasse during a stop makes it necessary to use extra fuel, while the sudden change in steam demand upsets the balance of the plant. Frequent startings with loaded mills increase the strain on the mill foundations, gear trains, couplings, and on the mill itself, all contributing to shortening the expected life of the equipment.

During the period from January to September last year there were no fewer than 205 stoppages at Ewa causing delays amounting in all to 52 hours. These were due to the presence of rocks in the crusher (122), in the knives (69) and in the cane carrier (14). Cane carrier jams and mill jams, however, were really not caused by rocks or tramp iron, but were the result of the unequal distribution of cane in the carrier, and the polishing of the rollers by the dirt and sand.

It is evident that if high extraction and recovery standards are to be maintained at a reasonable maintenance cost, it will be necessary so long as machine loading is used to devise some means of separating the soil, rocks and tramp iron before such material enters the mill. The Labour-saving Devices Committee is now studying several methods of doing this by the application of water. If the cane can be spread out in a thin layer and rolled about, it would seem reasonable to believe that the soil can be washed from the stalks, and that the rocks and tramp iron will fall into properly arranged traps. It is likely that something on these lines will be tried.—(*Int. Sugar Jr.*, Vol. XXXIX, No. 465, 1937. p. 361.)

* *See* Peck *I. S. J.*, 1931, p. 547.

* * *

Utilization of Molasses.—*A. R. Lamp.*

Experiments on the use of anhydrous ethyl alcohol (absolute alcohol) blended with gasolene have corroborated the reports to be found in the literature that ten per cent. of the former can be mixed with the latter to give a motor fuel which can be used in any modern automobile engine with no appreciable change in power, efficiency and economy, but with a distinct lessening of "knocking". Citric acid was successfully produced by the fermentation of molasses with *Aspergillus niger* and recovered with a fair yield, but the proposition has been abandoned owing to market conditions being against it. Experiments on the feeding of molasses and other local feeds to cattle have shown that it is possible to produce fat, well finished beef carcases good enough to compete successfully with choice beef imported from the mainland. Bagasse and alfalfa admixtures to rations for animals (rabbits), and the former found to give superior results, the conclusion being that "bagasse has a value in feed mixtures for herbivorous animals as a producer of energy".—(*Inter. Sugar Journal*, Vol. XXXIX, No. 464, p. 323, 1937.)

* * *

Automatic Safety Closing of Centrifugal Covers.—*By H. Bayha.*

A cover closing device for centrifugals is described depending on the use of an electro-magnet actuated through a relay by a special tachometer operating a system of compound levers which raise or lower the cover. At a certain rate of revolution of the machine, the magnet is deprived of current, and the cover remains closed; at rest or at a low speed the magnet receives current, draws up its core, and raises the cover. A further arrangement prevents throwing in the motor while the cover still remains open. — (*Int. Sugar Jr.* Vol. XXXIX, No. 465, p. 350.)

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

The Curing of Cashew Nuts for Export.—*By A. W. R. Joachim.*

The metods of curing the cashew nuts for export in Southern India have been studied with a view to their modification or improvement in Ceylon. The removal of the pericarp or shell requires a previous slight roasting to eliminate the caustic oil it contains and to render the nuts brittle. In South India this is done in open iron pans over small earthenware furnaces fed by the rinds of previously shelled nuts. The period of roasting is one minute, great care being taken not to brown the nuts and so render them unfit for export. The smell from these factories is so unpleasant that they have to be situated away from residential districts. Roasting in electrically heated ovens at different temperatures showed that below 100°F. the shells remained tough and at 120°F. showed browning. A machine roaster from South India discoloured more nuts than the open pan method. A chimney to remove the gases by suction might be successful but would be expensive. The highly skilled process of shelling is the next operation. This is done by women and boys, the shell being cracked with a wooden mallet, and the kernel removed with a wire prong. The reddish-brown inner seed coat has also to be removed. This is done in India by spreading the nuts on wire gauze trays in hot air rooms at 120°F. for 3 hours, the seed coat being removed by this drying. In Ceylon 155°F. was found more suitable. At higher temperatures than this the kernels become brittle. The tendency for the gauze to mark the kernels could be avoided by the use of a textile fabric. On removal from the hot air chamber the nuts are peeled by hand, then spread on the floor where they absorb some moisture and become less brittle. Grades of kernels are (1) wholes, (2) halves, of one cotyledon only, (3) brokens, and (4) rejects or spoils. Only wholes and halves are exported, the latter fetching a much lower price. The dried and graded nuts are packed in 25 lb. tins which are subsequently vacuumized through a small hole in the lid, the former practice of charging the tins with carbon dioxide gas being objected to by importers. Nuts packed by either method will keep for at least two years, and if merely packed in hermetically sealed tins for at least one year. By-products might have some local use. Rind oil can be obtained by heating the kernels to 120°C. or higher for 3 hours. Ways of doing this are described. The oil is used as wood-paint for treating fishing nets and has been used in the manufacture of bakelite. Its value, however, commercially is so much less than that of the kernels that it is not profitable to extract it. The chief constituents are anacardic acid, gallic acid and cardol. The testa or seed coats and the broken kernel tips form a poultry food of high nutritive value, analysis showing the following percentages:—water 8.1, proteins 7.6, taf 12.3, carbohydrates 59.2, fibre 11.0, ash 1.8. A gum produced from incisions in the tree is reported to be insect proof and could be used in book-binding. A fermented spirit can be prepared from the juice of the pedicels. The juice contains 8-12 per cent. of reducing sugars and has anti-scorbutic properties.—(*Imp. Bur. of Fruit Prod. Hort. Abs. Vol.* VI, No. 3, p. 216, 1936.)

* * *

Tung Oil Trials in the British Empire.

The latest issue* of the quarterly *Bulletin of the Imperial Institute* (obtainable from the Institute, price 2*s.* 9*d.* post free) records the results of examination of a large number of samples of tung seed and oil received from various countries of the Empire where the trees are the subject of experimental plantings.

Two kinds of tung tree are concerned, *Aleurites fordii*, which does best under warm temperate conditions and *Aleurites montana*, which requires a hotter climate. The oil from the former is most in demand and it is this kind that has been the subject of most of the trials. Nuts and seeds from experimental plantings have been received from India, Ceylon, South and East Africa, Australia, Cyprus and British Honduras. Tables are given showing the characters of the fruits, nuts and kernels and of the oils obtained from the kernels. The results are satisfactory in almost every case, showing that oil equal in quality to the ordinary commercial article can be obtained from Empire-grown nuts. The question whether they can be produced economically on a commercial scale is the next problem to be solved.

* * *

Oil Palm Production in the Belgian Congo.

Professor E. Le Plae, of the University of Louvain, in an article published in the *Bulletin of the Imperial Institute*,* on the development of oil palm plantations in the Belgian Congo, states that progress is being made in two directions: by the establishment of steam mills for preparing the oil from the fruits, of which there are now 73 in the country, and by the selection of high-yielding palms for propagating purposes. In the latter connection an account is given of the work being carried out at the various Government plantations where the improved varieties are being grown. During the last eight years over 7,000,000 seeds of improved or selected strains have been distributed, mainly for planting on native farms. Figures are given showing the rapid progress made in the exports of palm products from the Belgian Congo. The total tonnage of oil and kernels shipped in 1920 was 47,079 tons and in 1935, 124,157 tons, an increase of 164 per cent. Nigeria, in the same period, increased her shipments from 300,085 tons to 462,552 tons, or 54 per cent.

* Vol. XXV, No. 2, 1937.

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—Prices on the Home Markets have ranged as follows (*c.i.f.* per cwt.)

	Foreign.		*Preferential.*	
	s.	*d.*	*s.*	*d.*
26th August	6	3¾	10	0
2nd September	6	4½	10	1½
9th September	6	6¾	10	4½
16th September	6	5¼	10	1½
23rd September	6	6	10	3
30th September	6	6	10	3
7th October	6	6	10	3
14th October	6	6	10	3
(15*th October*, 1936)	4	5¼	8	3

The course of the market has been somewhat erratic during the period under review but the prevailing tendency has been one of firmness. The Sino-Japanese conflict has been construed rather as a bearish factor than otherwise owing to the possible interruption of the normal flow of trade in the commodity throughout the area of hostilities, not to mention its effect on internal consumption in China. Recurrent shocks in the European political arena have dictated a cautious policy and nervousness will undoubtedly continue. A favourable feature is the good rate of absorption by the United Kingdom where total consumption of all sugars during the 10 months period October to July, expressed in raw value, was 1,992,700 tons as against 1,908,700 tons during the same period last year.

* * *

RUBBER.—Quotations for Plantation Sheet have ranged as follows:—

	Pence per lb.
25th August	8 7-8
1st September	8 7-8
8th September	9 1-8
15th September	9
22nd September	8 7-8
29th September	8 1-2
6th October	7 5-16
13th October	7 7-8
(14*th October*, 1936)	7 15-16

During the early part of the period under review prices rose in response to heavy buying by American Manufacturers, and the covering by American dealers of their short interests. This buying was hastened by the position of affairs in the East with the possibility of shortage of freight space and by the fear that the rates for war risk insurance may rise abruptly at any moment. Subsequently, in sympathy with the stock markets and in response to the unsettled international political outlook, the market became easier and prices have now fallen to lower levels. According to the *American Questionnaire* consumption for August is 41,456 tons as against 43,650 tons for July.

COCOA.—Manufacturers generally still feel justified in adopting a waiting attitude and are, no doubt, of the opinion, that world spot supplies, afloats and incoming crops are sufficiently large to take care of their anticipated requirements. Many in the trade believe that their bins are running low, but this possibility is not substantiated by the absence of demand for spot or afloat supplies and their limited buying of later shipments. Accra cocoa is quoted at 29*s.* 6*d.* whilst locally Plantation cocoa is nominally quoted at $9.50 per fanega.—*By courtesy of the Cocoa Planters' Association of Trinidad, Ltd.*

* * *

COTTON.—The following are the official spot prices in pence per lb. of the Liverpool Cotton Association.

	American Mid.	*Egyptian F.G.F. Sakel.*
27th August	5.63	8.18
3rd September	5.56	8.18
10th September	5.46	8.02
17th September	5.33	7.86
24th September	5.08	7.68
1st October	4.88	—
8th October	4.74	—
15th October	4.82	—
(16*th October*, 1936)	6.99	10.90

Foreign political news has had rather a depressing influence on prices. Buyers have been rather cautious while the bearish statistics published by the U.S.A. Government have brought out some hedge selling. With regard to crop control for next season, it is expected that the yield will be kept down to around 12½ million bales, as against 16 million this season but this news has had practically no effect upon prices. There has only been a small inquiry for West Indian Sea Island, spinners generally still hoping for lower prices. A few small sales of Extra Fine have been made at 23.50*d.* to 24*d.*

* * *

BANANAS.—Steady demand with price for Jamaicas unchanged at £19 5*s.* per ton delivered London, and £19 nearest Provinces. Brazilians in slow request and £1 per ton lower at £14 delivered London and £15 delivered Provinces.

* * *

LIME PRODUCTS.—*Lime Oil.*—Handpressed is unchanged at 35*s.* to 37*s.* 6*d.* per lb. and Distilled at 25*s.*, but the demand is slow. *Lime Juice.*—There is still no inquiry for Concentrated and only a small demand for Raw, which continues to be valued at 1*s.* 10*d.* to 2*s.* 3*d.* per gallon.—(*West India Committee Circular*, 23rd September, 1937.)

IMPERIAL COLLEGE OF TROPICAL AGRICULTURE

COLLEGE NEWS BULLETIN

DECEMBER, 1937.] [No. 2.

COLLEGE NEWS.

The Principal returned to Trinidad by the S. S. *Costa Rica* on 30th September.

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Mr. R. C. Wood, Professor of Agriculture, arrived in Trinidad by the S. S. *Venezuela* on 18th September.

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Mr. G. R. Langdale, Bursar, returned from England with his wife and son on the M. V. *Colombia* on 3rd September.

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Mr. G. G. Gianetti, Editor of "*Tropical Agriculture*", Registrar and Librarian has been appointed Dean of the College.

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Dr. A. M. Adamson, Reader in Entomology, returned from California on 6th October, travelling by plane from Puerto Rico.

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Mr. F. Hardy, Professor of Chemistry and Soil Science, who spent his vacation leave in the U. S. A. returned by plane on 29th September.

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Dr. J. R. Dickson, Medical and Health Officer, accompanied by Mrs. Dickson returned by S. S. *Costa Rica* on 30th September.

* * *

Mr. G. A. Jones, Commissioner of Agriculture was appointed by the Secretary of State as a member of the Commission of Enquiry which has been investigating the character and causes of the recent disturbances in Trinidad.

* * *

Mr. S. H. Crowdy, who has been appointed Lecturer in Mycology, arrived by the S.S. *Colombie* on 6th October. Mr. Crowdy was educated at London University where he obtained a B.SC. with honours in Botany, and also graduated as A.R.C.S.

We offer our heartiest congratulations to Professor C. Y. Shephard on his award of the Degree of Doctor of Philosophy by the University of London. He returned from vacation leave accompanied by his wife and son, by the S.S. *Costa Rica* on 30th September.

* * *

Our thanks are due to George Kent, Ltd., Engineers, who have presented a Multelec pH Recorder to the College Department of Sugar Technology, for installation in its Experimental and Instructional Sugar Factory. This equipment should prove of great assistance to the study of the more scientific methods of sugar production.

* * *

A party consisting of Sir Mark Young, Governor of Barbados and Lady Young accompanied by Captain J. A. Lamb, and of Mr. John Forster, Sir Arthur Pugh, Mr. F. Fitzgerald and Mr. K. Vincent Brown, members of the Commission of Enquiry, visited the College on 26th October and were entertained to lunch by the Principal in the College Dining Hall.

* * *

We have pleasure in acknowledging the presentation of two more agricultural implements which will be added to the Professor of Agriculture's collection. From Uganda Mr. Davidson (1929-30), has sent us a "lango" hoe, while from the same colony Mr. Purseglove (1935-36), has sent us a very interesting combined chopper and weeder made from locally mined iron. Both gifts are much appreciated.

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We extend our heartiest congratulations and best wishes to Miss Eyvoll McIntosh who was Senior Clerical Assistant in the Administration Department of the College on the event of her marriage to Mr. J. H. Gisborne, which took place on 9th October at Old Marston, Oxford. Mr. Gisborne came to Trinidad as a Colonial Office Scholar during the 1934-35 session and is now serving in the Nigerian Department of Agriculture.

At the close of last Session Mr. R. G. Fennah, who had been in charge of the Entomology Department in the absence of the Reader left for St. Lucia on 22nd June, accompanied by Mrs. Fennah, to continue his work as Entomologist of the Citrus Pest Investigation. During the subsequent three months he visited Montserrat and Dominica, returning to Trinidad by the "*Lady Drake*" on 6th October. He and his wife will probably be going North again this month.

* * *

Mr. F. W. Cope, the Junior Botanist for Cacao Research, who arrived by the S.S. *Venezuela* on 18th September, was educated at London University, where he obtained the B. SC., with first class honours in Botany and Zoology, and also graduated A.R.C.S. with first class honours, being first in order of merit. Previous to his present appointment, Mr. Cope was doing research in plant physiology at the Research Institute of Plant Physiology, Imperial College of Science and Technology.

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Recent visitors to the College included Dr. L. R. Hutson, Veterinary Officer, Leeward Islands; Ratu J. L. V. Sukuna, District Commissioner, Lau, Fiji; Professor Dr. Richard Harder, Gottingen; Mr. J. A. Barboza Carneiro, Rio de Janeiro; Mr. and Mrs. T. N. Hoblyn of The East Malling Research Station; Dr. E. Deichmann, Assistant Curator of Marine Invertebrates in the Museum of Comparative Zoology, Harvard College; Dr. J. Smart, British Museum; Mr. N. Y. Sandwith, Royal Botanic Gardens, Kew, and Captain H. E. Morse, *H.M.S. York.*

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Mr. E. McCallum Callan, who has been appointed Lecturer in Entomology, arrived in Trinidad by the M.V. *Colombia* on 3rd September. Mr. Callan was educated at Manchester University where in 1932 he graduated B.SC. in Zoology. He then joined the Imperial College of Science and Technology, and in 1934 graduated A.R.C.S with first class honours in Entomology. From 1934-36 he worked as a research student at the University of London under Professor J. W. Munro, and in 1937 obtained the D.I.C. In 1936, he was appointed Research Entomologist under the Forestry Commission and the Agricultural Research Council for Entomological Research in connection with the watermark disease of the cricket bat willow. Mr. Callan, who is a Fellow of the Royal Entomological Society of London, has also worked for short periods at Rothamsted and in France.

Dr. E. C. Humphreys, Lecturer in Chemistry, arrived in Trinidad by the S.S. *Costa Rica* on 30th September. Dr. Humphreys was educated at London University, where he obtained a B.SC. in Botany and Chemistry in 1933 and a PH.D. in plant physiology in 1936. From 1935-36 he held a temporary appointment as Lecturer and Demonstrator at Leeds University, and from 1936-37, he did research work in plant biochemistry at the Botany School, Cambridge, under Dr. E. J. Maskell.

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Dr. K. S. Dodds, B.SC., PH.D., who has been appointed Lecturer in Botany arrived by the S.S. *Venezuela* on 18th September. He was educated at Armstrong College, Durham University, where he took a B.SC. with first class honours in Botany. In 1933 he was awarded a research grant by the Department of Scientific and Industrial Research and spent two years carrying out research for the PH.D. degree in the Department of Botany at Armstrong College. In 1935 he was awarded the Earl Grey Memorial Fellowship which enabled him to spend a further 18 months in research at the Indiana State University, U. S. A. Dr. Dodds obtained the PH.D. degree in 1937 and was demonstrator and part-time lecturer at Armstrong College before his present appointment.

* * *

The following nominations to the Governing Body of the College for four years have been made :—

Sir Norman Lamont Bt., Mr. G. Moody-Stuart, C.B.E. and Captain W. F. Watson, O.B.E., by the Government of Trinidad and Tobago; Professor F. L. Engledow, C.M.G., M.A., by the University of Cambridge; Emeritus Professor J. Graham Kerr, M.A., LL.D., F.R.S., M.P., by the University of Glasgow; Professor Sir John Farmer, M.A., D.SC., LL.D., F.R.S., by the Imperial College of Science and Technology; Mr. George Douglas Laurie Pile, B.A., by the Government of Barbados; Sir Albert Charles Seward, D.SC., F.R.S., late Professor of Botany at Cambridge University by the Colonial Office in succession to Sir David Prain. The Viscount Elibank and Mr. E. R. Darnley, M.A. have been coopted as members for a further term of four years and Sir Leonard Lyle, BT. has been coopted as a representative of Sugar Refining.

Dr. D. W. DUTHIE.

Dr. D. W. Duthie has resigned his post as Lecturer in Chemistry at the College to become Chemist to the British Guiana Department of Agriculture. Dr. Duthie, who left Trinidad on 2nd August, was educated at Aberdeen University, where he took his M.A. in 1925, and a B.Sc. with honours in Chemistry in 1927. During the same year, he was elected Associate of the Institute of Chemistry. After leaving the University, he joined the staff of the Rowett Research Institute as Assistant in the Biochemical Department. In 1928, he obtained an appointment with the Nitrate Corporation of Chile as Assistant to Dr. F. C. Kelly, who was Technical Adviser to the Iodine Department, and, in 1930, as a research worker for the same Corporation, he went to Cambridge where he was attached to the staff of the Institute of Animal Pathology.

In 1931, Dr. Duthie was offered and accepted the post of Lecturer in Chemistry on the Staff of the Imperial College of Tropical Agriculture. In addition to his duties as lecturer and demonstrator in geology, organic chemistry and biochemistry, Dr. Duthie carried out a fundamental investigation into the chemical composition of soil organic matter with special reference to tropical soils, for which he was awarded the Ph.D. of Aberdeen University in 1935. He also initiated and supervised a new line of mineralogical work on tropical soils, studied the problem of forest soil deterioration, and, just before he resigned, had undertaken various biochemical investigations on cacao. He has recently been elected Fellow of the Institute of Chemistry of Great Britain and Ireland. Dr. Duthie was a good lecturer, a very efficient member of his Department, and a splendid organiser. He entered whole-heartedly into various other College activities, and was for two years honorary secretary to the College Amalgamated Clubs. He was particularly good at hockey, and played for several years in the College XI. His popularity gained him many friends in Trinidad, who will be sorry to lose him.

The very best wishes of the Staff and Students go with him in his new sphere of activities.

BIRTH

Hoyle.—On 16th September, 1937 to Joan (*nee* Asher) wife of Stephen Thomas Hoyle, Salima, Nyasaland, a son.

COLLEGE SESSION, 1937-38.

The 1937-38 Session began on 4th October, with the following students in residence :—

DIPLOMA STUDENTS.

1st Year.

G. M. Bryant (Antigua); M. R. Cuke, J. W. T. Dunlop and K. G. Proverbs (Barbados); S. C. Shillingford (Dominica); L. N. L. Kerr, G. J. B. Murray and E. L. S. Robertson (Trinidad); and M. I. Campbell (South Africa).

2nd Year.

L. H. Lord (British Guiana); W. Ryle Davies (England); C. G. W. Munro (Grenada); J. G. Smith (Guatemala); T. Chinloy, M. D. ffrench-Mullen and E. D. Weller (Jamaica); H. T. Carrington (Montserrat); H. H. Beach and H. T. Foster (St. Kitts); W. A. Flook, W. A. Rose and M. S. Sampath (Trinidad); C. M. Salazar (Venezuela).

3rd Year.

O. F. J. Churaman (British Guiana); B. N. Ray (India); W. G. Stuart (Jamaica); P. J. Sauvage (Seychelles); F. O. Gonzales (Trinidad).

3rd Year Sugar Technology.

J. N. Bagchi (India).

4th Year Sugar Technology.

R. S. Patel (India).

Colonial Office Scholars.

G. W. Anderson, B.Sc. (Agric.), Edindurgh.

G. K. G. Campbell, B.Sc. (Hons.), St. Andrews.

H. D. L. Corby, B.S.A., Toronto.

F. J. Harper, B. Sc., (Hons.), Nottingham.

D. G. Jones, B.A., (Hons.), Cambridge.

L. J. S. Littlejohn, B.Sc., (Hons.), Glasgow.

H. T. Measures, B.A., (Hons.), Cambridge.

S. McCombe, B.Sc., (Agric.), Belfast.

P. F. Stephenson, B.Sc., (Hons.), A.R.C.S., London.

R. K. Tremlett, B.Sc., (Hons.), A.R.C.S., London.

Gold Coast Government Scholars.

A. E. Chinbuah, B.Sc. (Ag. Econ.), California.

A. N. de Heer, B.Sc. (Agric.), California.

Empire Cotton Growing Corporation Scholar.

H. B. Newcombe, B.Sc., Acadia.

Special. (*Sugar Technology*).

J. M. Smith (British Guiana).

EXAMINATION RESULTS, 1936-37.

YEAR I. — The following candidates satisfied the examiners in the first year examinations for the Diploma and have proceeded to the 2nd Year course :—

H. H. Beach.
H. T. Carrington.
T. Chinloy.
W. Ryle Davies.
D. P. S. Delgado.
M. D. ffrench-Mullen.
W. A. Flook.
H. T. Foster.
L. H. Lord.
C. G. W. Munro.
W. A. Rose.
C. M. Salazar.
M. Sampath.
J. G. Smith.
E. D.H. Weller.

YEAR II. — The following candidates satisfied the examiners in the second year examinations for the Diploma and proceeded to the 3rd Year course :—

O. F. J. Churaman.
F. O. Gonzales.
P. J. Sauvage.
W. G. Stuart.

YEAR III.—The following candidates satisfied the examiners in the third year examinations for the Diploma and have been awarded the Diploma of the College :—

D. L. Foster
A. O. Harris.
O. C. Henriques.
I. Hosein.
K. M. Houlder.
E. R. H. Martin.
W. R. E. Nanton.

YEAR III. (*Sugar Technology*). — The following candidates satisfied the examiners in the third year examinations for the Diploma in Sugar Technology and have been awarded the Diploma of the College in that subject :—

D. M. Khandke.
E. P. Schonbeck.

OLD STUDENTS' CORNER.

B. de L. Inniss (1935-36) has gone to the Gold Coast as Agricultural Superintendent.

* * *

D. H. Welch (1936-37) has been appointed Agricultural Officer in the Department of Agriculture, Nigeria.

* * *

G. K. Argles (1933-34), has been appointed Manager of the Jamaica Fruit and Vegetable Development Scheme.

E. F. Allen (1936-37) and A. B. Lucy (1936-37) have gone to Malaya as Agricultural Officers.

* * *

A. F. Posnette (1936-37) has been appointed Botanist, Department of Agriculture, Gold Coast.

* * *

N. S. Haig (1923-24) Agricultural Officer, Uganda, has been promoted to Senior Agricultural Officer.

* * *

C. L. Willding-Jones (1931-32) has resigned his appointment in the Department of Agriculture, Gold Coast.

* * *

W. E. Freeman (1932-33), late Tobacco Breeding Officer, Mauritius, has joined the Department of Agriculture, Nigeria, as Botanist.

* * *

E. J. H. Berwick (1934-35), Agricultural Officer, Perak Central, has been transferred to the Central Experimental Station, Serdang, as Acting Agriculturist.

* * *

Arrangements have been made for J. McN. Wingate (1928-29) Gold Coast Department of Agriculture, to visit Ceylon and India in order to study the cooperative movement in those countries.

* * *

E. L. Hay (1936-37) and T. G. Strangeways (1930-31) have been promoted from Inspectors of Plants and Produce to Agricultural Superintendents in the Gold Coast Department of Agriculture.

* * *

E. G. A. Benson (1929-30) has been promoted from Assistant Agricultural Superintendent to Agricultural Superintendent in the Department of Agriculture, British Guiana.

MARRIAGE.

We offer our heartiest congratulations and best wishes to C. W. Lynn (1928-29), on his marriage to Marjorie Beatrice Barnard on 28th August, 1937, at St. Clement Danes.

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